MINISTRY OF
AGRICULTURE, FISHERIES AND FOOD

TECHNICAL BULLETIN 25

Diseases of Cultivated Plants 1957-1968

HER MAJESTY'S STATIONERY OFFICE

For more than 50 years the Ministry of Agriculture, Fisheries and Food and its forerunners have collected information on the occurrence of diseases of crop and ornamental plants in England and Wales. Condensed summaries have been published from time to time to provide an assessment of the relative importance of the diseases and of the effectiveness of the control measures used to combat them.

This report covers the 12 years 1957-68 and includes data collected during advisory and survey visits supplemented by relevant published information from research stations, university departments etc. It covers the wide range of plants in cultivation (excluding forestry) and the fungi, viruses, bacteria and non-parasitic agents which afflict them. Thus it provides a comprehensive reference book for those, both in this country and abroad, who are interested in the current disease position, and should be particularly useful to advisers, plant protection personnel and plant breeders who can help to prevent the losses caused by these diseases.

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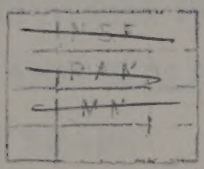

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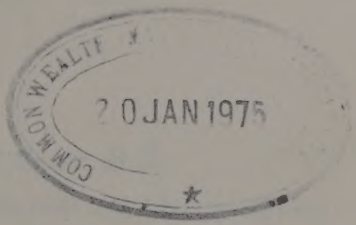

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

Technical Bulletin 25

REPORT ON DISEASES OF CULTIVATED PLANTS IN ENGLAND AND WALES FOR THE YEARS 1957 - 1968

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(Agricultural Development and Advisory Service)
Plant Pathology Laboratory, Harpenden

LONDON
HER MAJESTY'S STATIONERY OFFICE
1972

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Abbreviations used for Counties

The names of the counties of England and Wales appear in the reports as follows. Where possible the abbreviations are those recommended in *Authors' and Printers' Dictionary* by F. H. Collins, 10th edn, 1960, London: Oxford University Press.

Anglesey	...	Anglesey	
Beds	... ...	Bedfordshire	
Berks	... ...	Berkshire	
Brecon	... ...	Breconshire	
Bucks	... ...	Buckinghamshire	
Caerns	... ...	Caernarvonshire	
Cambs	... ...	Cambridgeshire	
Cards	... ...	Cardiganshire	
Carms	... ...	Carmarthenshire	
Ches	... ...	Cheshire	
Cornwall	...	Cornwall	
Cumb	... ...	Cumberland	
Denbigh	...	Denbighshire	
Derby	... ...	Derbyshire	
Devon	... ...	Devon	
Dorset	... ...	Dorset	
Dur	... ...	Co. Durham	
Essex	... ...	Essex	
Flints	... ...	Flintshire	
Glam	... ...	Glamorganshire	
Glos	... ...	Gloucestershire	
Hants	... ...	Hampshire	
Herefs	... ...	Herefordshire	
Herts	... ...	Hertfordshire	
Hunts	... ...	Huntingdonshire	
I. of Ely	...	Isle of Ely	
I.W.	... ...	Isle of Wight	
Kent	... ...	Kent	
Lancs	... ...	Lancashire	
Leics	... ...	Leicestershire	
Lincs	... ...	Lincolnshire	
Merioneth	...	Merionethshire	
Middx	... ...	Middlesex	
Mon	... ...	Monmouthshire	
Montgomery		Montgomeryshire	
Norfolk	... ...	Norfolk	
Northants	...	Northamptonshire	
Northumb	...	Northumberland	
Notts	... ...	Nottinghamshire	
Oxon	... ...	Oxfordshire	
Pemb	... ...	Pembrokeshire	
Radnor	... ...	Radnorshire	
Rutland	...	Rutland	
Salop	... ...	Shropshire	
Som	... ...	Somerset	
Staffs	... ...	Staffordshire	
Suffolk	... ...	Suffolk	
Surrey	... ...	Surrey	
Sussex	... ...	Sussex	
War	... ...	Warwickshire	
Westmorland		Westmorland	
Wilts	... ...	Wiltshire	
Worcs	... ...	Worcestershire	
Yorks	... ...	Yorkshire	
(Riding of Yorks thus:			
E.R. – East Riding)			

Other Abbreviations and Conventions

The names of the common diseases are, where possible, those recommended in the *List of common British plant diseases* compiled by the Plant Pathology Committee of the British Mycological Society, 1962, 4th edition, Cambridge University Press.

The names of viruses are those given in *Plant virus names*, Phytopathological Papers, No. 9, 1968, Ed. E.B. Martyn, Kew: Commonwealth Mycological Institute.

Abbreviations used in references are from *World list of scientific periodicals*, Vols. 1 to 3, 1963-5, 4th edition, London: Butterworths.

Certain books referred to have been abbreviated thus:

Grove, *Br. Coelomycetes*	W. B. Grove, *British stem- and leaf-fungi (Coelomycetes)*, Vols. 1, 1935, and 2, 1937, Cambridge University Press.
Moore, *Br. Parasitic Fungi*	W. C. Moore, *British parasitic fungi*, 1959, Cambridge University Press.
Grove, *Br. Rust Fungi*	W. B. Grove, *The British rust fungi (Uredinales)*, 1913, Cambridge University Press.
Wilson and Henderson, *Br. Rust Fungi*	M. Wilson and D. M. Henderson, *British rust fungi*, 1966, Cambridge University Press.
Peace, *Pathology of Trees and Shrubs*	T. R. Peace, *Pathology of trees and shrubs*, 1962, Oxford: Clarendon Press.
Smith, *A Textbook of Plant Virus Diseases*	K. M. Smith, *A textbook of plant virus diseases*, 1957, 2nd edition, London: J. & A. Churchill.
Saccardo, *Syll. Fung.*	P. A. Saccardo, *Sylloge fungorum*, 1822-1931, Padua.

Other abbreviations are as follows:

C.M.I.	Commonwealth Mycological Institute, Kew.
East Malling	East Malling Research Station, Kent.
G.C.R.I.	Glasshouse Crops Research Institute, Rustington, Littlehampton, Sussex.

Long Ashton	Long Ashton Research Station, University of Bristol.
M.A.F.F.	Ministry of Agriculture, Fisheries and Food.
N.A.A.S.	National Agricultural Advisory Service.
N.I.A.B.	National Institute of Agricultural Botany, Cambridge.
N.V.R.S.	National Vegetable Research Station, Wellesbourne, Warwick.
O.S.T.S.	Official Seed Testing Station, Cambridge.
Rothamsted	Rothamsted Experimental Station, Harpenden, Herts.
W.P.B.S.	Welsh Plant Breeding Station, Aberystwyth.

The Eight Regions of the National Agricultural Advisory Service
showing Regional Centres and Sub-Centres

Region	Centre
1 **Northern**	**Newcastle**
2 **Yorkshire and Lancashire**	**Leeds**
3 **East Midland**	**Shardlow**
4 **Eastern**	**Cambridge** with **Cheshunt** (Advisory Unit)
5 **South-eastern**	**Reading**
6 South-eastern Sub-Region	Wye (Sub-Centre)
7 **South-western**	**Bristol**
8 South-western Sub-Region	**Starcross** (Sub-Centre)
9 **West Midland**	**Wolverhampton** with **Evesham** (Area Laboratory)
10 **Wales**	**Aberystwyth**
11 South Wales Sub-Region	**Cardiff** (Sub-Centre)
12 North Wales Sub-Region	**Bangor** (Sub-Centre)

A map showing the eight Regions of the National Agricultural Advisory Service is presented on p. vii.

N.A.A.S. Plant Pathologists during 1957-1961 (Part I)

A. Beaumont
J. Bradley Jones
G. H. Brenchley
W. Campbell
J. P. Cleary (—1960)
L. J. Cock
H. E. Croxall
W. T. Dale (1958—)
D. L. G. Davies
Dorothy M. Derbyshire (1960—)
S. G. Evans
Marguerite C. Findley
J. T. Fletcher (1958—)
H. H. Glasscock
D. C. Gwynne
J. H. Hawkins
T. D. Holmes
D. R. Humphreys-Jones
June V. Ives (—1960)
J. E. E. Jenkins
Moyra Jones (—1958)
J. S. Knapman
B. C. Knight
E. Lester
S. C. Melville
Theresa M. Norman
L. Ogilvie
M. Elizabeth Parry (1959—)
N. C. Preston (—1957)
E.T. Roberts
W. R. Rosser
Elizabeth R. Schofield
I. F. Storey
R. E. Taylor
B. B. Till
I. G. Thorpe
A. G. Walker
E. R. Wallace
D. Wiggell
P. Wiggell
H. J. Wilcox

N.A.A.S. Plant Pathologists during 1962-1968 (Part II)

Annette B. Alonso (1966—)
D. Ann (1967—)
A. Bainbridge (1966—)
J. Bradley-Jones
G. H. Brenchley
W. Campbell
L. J. Cock
R. J. Cook (1964—)
I. A. Cragg
H. E. Croxall (—1966)
W. T. Dale
D. L. G. Davies
Dorothy M. Derbyshire
E. J. Evans (1966—)
S. G. Evans
Marguerite C. Findley (—1963)
J. T. Fletcher
H. H. Glasscock
G. W. Griffin
D. C. Gwynne
J. H. Hawkins
S. A. Hill (1967—)
D. R. Humphreys-Jones
J. E. E. Jenkins
B. C. Knight
E. Lester
S. C. Melville
Theresa M. Norman (—1964)
L. Ogilvie (—1964)
Dinah Page (1967—)
M. Elizabeth Tiley (née Parry)
E. T. Roberts
W. R. Rosser
C. L. J. Ryan
Elizabeth R. Schofield
P. J. Shipton
Carol J. Simpson (née Brierley) (1964—)
I. F. Storey
R. E. Taylor
I. G. Thorpe
M. E. Upstone (1963—)
A. G. Walker
E. R. Wallace
Patricia J. Weaver (1964-67)
D. Wiggell
P. Wiggell
H. J. Wilcox
D. J. Yarham (1964—)

Introduction

Since 1917, the present Ministry and its predecessors have collected information on the incidence and distribution of diseases and pests of cultivated plants in England and Wales and published it in a series of nine reports. The last two reports were written by W. C. Moore and reviewed the years 1933-42 (Bulletin 126) and 1943-46 (Bulletin 139).

It has been found difficult to keep the series up-to-date but, in 1959, Moore's *British Parasitic Fungi*, published by the Cambridge University Press, brought up-to-date (1956) the records of fungal diseases, the group which had formed by far the major part of each of the earlier reports on diseases. The present report begins where Moore's book left off. A script (Part I) reviewing the five years 1957-61 was prepared in similar detail to Bulletins 126 and 139 but, in order to bring the series as up-to-date as possible a Part II, in more abbreviated form, was added to cover the following seven years 1962-68. While Part I reviews, as far as possible, the incidence etc. of the reported diseases of cultivated plants caused by fungi, bacteria or viruses, and disorders of non-parasitic origin, and also cites the literature for the British Isles for 1957-61: Part II tries to indicate which are the most troublesome diseases and, for the major ones, the years in which they were most prominent; refers to the new and uncommon diseases and to changes in status of established diseases, and in general cites the literature for 1962-68 solely for England and Wales and in relation to the main topics of incidence, status etc., only. Diseases specifically concerning forestry are not included.

Many diseases of lesser importance which were reported in Part I have been omitted from Part II if their status has not altered.

The last year (1946) covered by the previous bulletin saw the setting up of the National Agricultural Advisory Service,* and it is the detailed monthly reports of the N.A.A.S. advisory Plant Pathologists and the annual reports of the Regional Pathologists which provide the main foundation for the present report. Material from the literature, research station annual reports and elsewhere has been used where appropriate. The comments on sugar beet diseases are very largely derived from reports supplied by Broom's Barn Research Station, and the Ministry is indebted to the Director of the Station Dr. R. Hull for accesss to reports from the field advisers of the British Sugar Corporation.

Surveys by the N.A.A.S. in collaboration with Plant Pathology Laboratory have been made for a few of the major diseases and the results of these, largely published elsewhere, have been referred to. Quantitative data are still lacking for the great majority of diseases referred to in this report but, in spite of this, the information has some significance in that it reflects the relative importance of the diseases to farmers and growers throughout the country. It has been their concern and need for advice which has brought the advisers into contact with the problems. Some familiar diseases may not often be brought to the attention of advisers and it has been necessary to take this into account.

* Now the Agricultural Development and Advisory Service.

The space allotted to ornamental plants, greater than in previous reports, reflects the increased economic importance of this group. Another change is the disappearance of the flax crop, the acreage of which had expanded during the second world war. Since the last report, knowledge about virus diseases has increased very considerably and many were identified for the first time in these twelve years: very recently some viruses of the yellows type have been found to be mycoplasmas but this development has had to be left out of account.

Most of the photographs were taken by Mr. J. R. Morrison of the Ministry's Plant Pathology Laboratory, but a few were taken by his predecessor the late Mr. W. F. Buck, M.B.E. Plates III, 2, VIII, X, 1, XII, 2 and XVI, 2 were from N.A.A.S. photographs.

I am grateful to Dr. M. Hollings for a number of records of viruses found in ornamental plants. I am also grateful to all those colleagues who have helped with queries which have arisen during the preparation of the Report and to Miss. M. Pratt for help in locating British references in the literature.

J. J. Baker

March 1971

PART I

DISEASES OF CULTIVATED PLANTS, 1957-1961

Weather Conditions

More-detailed reports on the weather during 1957-61, *contributed by the Agricultural Branch of the Meteorological Office were published in* '*Plant Pathology*' (*No.* 3 *of Vol.* **6** *and Nos.* 1 *and* 3 *of Vols.* **7-11** *inclusive*). *The following are the main features:*

Of particular interest in the 1957-61 period was the series of fairly mild winters, and the very dull wet summer of 1958 contrasting with one of the outstanding summers of the century in 1959.

1957 The 1956/57 winter was persistently mild, one of the mildest this century in the east and south-east. A dry spring followed, and the summer began sunny, but the succeeding cool, dull, rainy weather lasted from June into autumn. Frosts came late and the remaining months were mild.

1958 Cold weather came in January, but the winter was not conspicuously cold and in the south was relatively mild. A cold spell in spring was followed by milder conditions, but the summer was particularly dull and wet throughout. Drier weather returned in mid-October but the last months were largely dull and foggy.

1959 A cold January was followed by mild weather from February onwards. February was also exceptionally dry. The summer was outstandingly warm and sunny and the weather continued mild into the winter. December was very wet. The total general rainfall from May to October over England and Wales was the lowest of the century or of even very much longer.

1960 Though wet, the winter was mainly mild. A dry late spring and early summer led to a wet July and August. A wet autumn and another relatively mild winter followed.

1961 The mild winter led to an abnormally early spring which stayed mild though April was wet, and damaging frosts occurred late in May. In the summer, warm spells were short. Autumn began mild, but colder weather followed and December was especially cold.

Diseases of Cereals

Published during the period were *Cereal Diseases* (*Bull. Minist. Agric. Fish. Fd*, No. 129, 1961) by W. C. Moore and F. J. Moore, and *Cereal Diseases in Ireland*, (1957 Dublin: At the Sign of the Three Candles) by R. McKay.

Wheat

Following one of the mildest winters of the century, **Yellow Rust** (*Puccinia striiformis* Westend.), the most damaging of the wheat rusts, appeared early in 1957, with April records from Kesteven (Lincs), Essex, Norfolk, Salop and Oxon. The fungus was very apparent in affected fields by late April, but it was not until June and July that the main development took place and it became common in much of the country. By mid-June, cv. Heines VII was badly attacked throughout the South-eastern Region, with 50 per cent infection common and yields much reduced, but few other cultivars were affected in the Region. In other areas, yellow rust was of little consequence except in some crops of Heines VII, although the Northern and East Midland Regions claimed a greater prevalence than in recent years. Tests, in 1957 and 1958, at the N.I.A.B. on specimens from different parts of the country detected only races 2b and 8b. Cultivars Cappelle Desprez, shown to be susceptible to race 2b, was reported by the Institute to have traces of rust more frequently in 1957 than previously. Though fewer crops of this cultivar were rusted in 1958, the level of infection was considerably higher (*Rep. natn. Inst. agric. Bot. 1957*, 19 and *1958*, 21).

In 1958, yellow rust was general in most areas by June, but in 1959 and 1960 it was late in developing. In all three years it was of little consequence other than on a few crops of susceptible cultivars such as Heines VII, Merlin or Flamingo.

In contrast, 1961 saw a more widespread and severe epidemic than for about 10 years. In April, infection was general throughout 48 acres of Cappelle Desprez in Worcs. A few outbreaks were seen in the Eastern Region in the second week of May, one of them probably being present five or six weeks earlier. May and June reports from the Regions indicated that yellow rust might become a problem and, certainly, Cappelle Desprez, Viking and Jufy I, cultivars grown on a considerable scale, were often moderately heavily infected. While most reports spoke of up to 20 per cent infection, some crops with up to and more than half of their active leaf area attacked were noted, e.g. of cvs. Red Mace and Viking in I. of Ely, though in the same area cvs. Hybrid 46 and Koga II bore traces only and none was seen on Professeur Marchal. A spell of hot dry weather in mid-summer appeared to have checked the fungus in much of the country, so that, finally, effect on yield was thought to be little in most places, though many thin grains were harvested. An account of the epidemic was given by Doling (*Pl. Path.* 1962, **11**, 91).

Increasing interest in yellow rust had been shown, internationally, following severe epidemics earlier in the 1950's. In 1960, a second Yellow Rust Conference was held (see *Nederlands Graan-Centrum, Wageningen, Technisch*

Bericht Nr. 5, 1962), at which Macer (pp. 35-45) discussed the inheritance of resistance, and Manners and Hartill (pp. 51-67) examined both the relationship between the extent of leaf rust and yield losses and the nature of the physiological and biochemical effects on the grain following attack on the leaves. Macer also reported on breeding wheat for resistance to the disease (*Trans. Br. mycol. Soc.* 1961, **44**, 135).

Observations on incidence in the field, and physiologic race identifications, made annually from 1951-56, were published by Batts (*J. natn. Inst. agric. Bot.* 1957, **8**, 7-18). Investigations on yellow rust in glasshouses had been hampered by cereal mildew epidemics, and the need for a differential fungicide was apparent: Doling and Hepple (*Nature, Lond.* 1959, **183**, 622) found dinocap to be valuable in this respect.

Black Stem Rust (*Puccinia graminis* Pers.) is of little economic significance in this country although, in favourable seasons, fortunately infrequent, it can become epidemic and reduce yields. It develops mainly from spores reaching these islands annually from the Continent. Particular interest had been aroused in recent years in the behaviour of cereal rusts in Western Europe, and at the International Congress of Plant Protection, Hamburg, 1957 it was decided to co-operate in an exchange of information. L. Ogilvie and I. G. Thorpe of the N.A.A.S. South-western Region were largely responsible for collecting data from this country, while R. C. F. Macer (Plant Breeding Institute) and D. A. Doling (N.I.A.B.) were mainly concerned with race identification. As on the Continent, a number of cereal plots were laid down, and observed each year since 1958 when co-operation began. On these 'rust nurseries', distributed in southern areas and in Wales, the appearance and development of black rust were recorded, but data were also collected from as many other sources as possible.

In 1957 and 1961, black rust was not seen until August, but it was recorded on 1 July in 1960, and in early July in both 1958 and 1959.

It appeared late in the south-west in 1957 and did little damage. First recorded on 2 August, in Devon, it was later found in southern parts of both Wilts and Dorset, one very late spring-crop being badly affected. A trace was seen on a plant in Staffs in September.

The early records of 1958 began with the Scilly Isles on 4 July. By the 11th, rust had been found in Kent, and later in the month in Devon and Dorset. In spite of this early start, development was slow possibly because of the lack of summer warmth; only late crops had substantial amounts and yields were mostly not reduced to any extent. Jufy I was heavily rusted in some trials. Eventually all but three of the 15 rust nurseries were affected. Occasional commercial crops in the south were rusted by August, and there were isolated records from Essex, I. of Ely and Worcs. In the south-east, virtually only late-sown cv. Koga II crops were affected. In Devon, a crop of this cultivar yielding 20 cwt per acre had probably been reduced by 5 or 6 cwt per acre because of rust. In the south-west, infection became widespread in places but remained slight. Attack was exceptionally heavy on late-flowering tillers on mown pathways between the plots on a trial ground in mid-Wales.

Crops ripened early in 1959 and the heat and the dryness may have prevented serious damage by rust. The first substantial spore catch made at Cardiff was on 15 July. A lone pustule was found on a rust nursery in Dorset on the same day; by the end of the month, records had come from rust nurseries in

Jersey, Devon and Dorset, and in a few crops in the south-east and south-west, with one from Cambs. Later reports, mainly in spring cultivars, came from southern counties of England and, a few only, from mid- and S. Wales. In the extreme south-west it did not occur until just before harvest. A trace was seen in a crop as far north as Yorks N.R., and rust was noted late in three places in the Eastern Region.

In the Wye Sub-Region it was thought that the rarity of the rust reflected the predominance of two wheat cultivars, Cappelle Desprez, of the winter, and Atle, of the spring wheats. This was indicated by assessments on N.I.A.B. demonstration plots at Wye, on 27 July, using a key in which estimates were based on the two internodes below the ear and in the areas of primary foci. While the winter cultivars Redman, Dominator, Banco, Minister and Hybrid 46 had 10 per cent of infection, Cappelle Desprez and Staring, had 1 per cent only and Bersee a trace to 1 per cent. The spring wheats were affected thus:

Atle, Fylgia II, and Peko—a trace; Svenno—a trace to 1 per cent;

Jufy I—1 per cent; Atson—5 per cent and Koga II—10 per cent.

The aecidial stage of the rust was present on seven of nine sites visited on a survey of *Berberis vulgaris* in mid-Wales in 1959.

In 1960, the first records came on 1 July, from Devon—on N.I.A.B. yellow rust plots and at a rust nursery. Following these, infection was seen at places all over southern England, the Channel Islands, Scilly Isles, Wales and Eire and had reached as far north as Aberystwyth, War and Lincs. One or two heavy attacks were noted. In the extreme south-west it became fairly common particularly on cv. Jufy II, but not serious. Stem infections were moderately severe on spring cultivars, in farm crops in S. Pemb. In the east of the country none of the few attacks reported was of any significance. A reminder of the 1955 national epidemic came from Hants where several thatches of Devon straw collapsed: in each case the straw was from the 1955 crop and the collapse attributable to black stem rust infection.

The late and very mild epidemic of 1961 did no significant damage. A rust nursery in S. Devon claimed the first record—on 10 August, though rust was noted on 4 August in Eire. By the end of August, reports had come from a few places only in the south-west, in mid-and S. Wales and the Scilly Isles. Later outbreaks were noted from Northants and Jersey, and in September it was present throughout a crop of cv. Professeur Marchal in Som. In Devon and Cornwall, by the end of the season, it had been recorded only in the rust nursery plot.

In 1958, all isolates of the rust from the south-west tested at the Plant Breeding Institute, Cambridge proved to be of race 21, a race known on the Continent. A number of races, with 21 the most frequent, were identified during 1959 and 1960, some of them for the first time in this country. During 1961 it was noticeable that race 21 was less frequently identified than previously while race 133 had increased in prevalence. Race 17, one of the more common ones identified in the two previous seasons, was recorded only once in 1961. Reports on the race identifications were given by Macer in the annual reports of the Plant Breeding Institute for these years.

At the first European Colloquium on Black Rust of Cereals, Versailles, 1958, the 1958 British epidemic was discussed by Ogilvie and Thorpe,

physiologic specialization in this country by Macer, and methods for trapping the spores by Hirst.

Black rust was a major topic at a meeting of the British Mycological Society in 1960 (*Trans. Br. mycol. Soc.* 1961, **44**, 136-9). Aspects covered were the West European and British investigations, work at Bristol on epidemics, weather and spore trapping in relation to recent epidemics, and the aerobiology of uredospores.

How far the rust affects yield of grain was studied by Batts and Elliot (*Pl. Path.* 1957, **6**, 45-6) in 1955, a year of severe attack. Manners and Bampton followed the fusion process with uredospore germ tubes of *P. graminis* var. *tritici* (*Nature, Lond.* 1957, **179**, 483-4). Ogilvie and Thorpe (*Sci. Progr. Lond.* 1960, **49**, No. 194, 209-27) discussed epidemics of the rust.

Generally thought to cause little harm, **Brown Rust** (*Puccinia recondita* Rob. & Desm. f. *tritici* Erikss. & Henn.) was noticed, to any extent, only in the South-western Region in 1957 and 1959, in I. of Ely in 1958, and in several areas in 1960. In the latter year the rust was general and above average in Devon and Cornwall, present over much of the east Midlands in July and common late in the season in the Yorks and Lancs Region. Heines VII was badly affected, while other cultivars only slightly so, in a trial in Herefs. Attack on Merlin was severe (50-70 per cent) in a trial in I. of Ely, while Hybrid 46, Cappelle Desprez and Marsters 57 less so, and spring- and winter-sown Koga II were free. Other infected cultivars mentioned in reports were Dominator, Milfast, Marne, Flamingo, Jufy I and Fylby.

Powdery Mildew (*Erysiphe graminis* Mérat) is considered to be of less consequence on wheat than on barley and oats. Most reports referred to cereal mildew without differentiating the host. Mildew was widespread and severe in most areas in 1957, the worst year of the five—following as it did a persistently mild winter and a dry spring. Levels were already high in some parts of the country by April e.g. over 50 per cent infection was recorded in certain cereal crops during March to April in N. Wales. Incidence was less severe generally in 1958, though in many areas mildew was conspicuous early in the season; in some Regions significance decreased with the onset of the prolonged wet weather. In the seasons 1959-61, not much mildew developed in early spring. Some crops were badly affected in 1959 in the eastern half of the country but the national picture was of later development and average or little infection. Although mostly at a low level early in 1960, the disease became widespread and often severe, and rather above normal in some localities. In 1961 mildew was not particularly troublesome in many Regions, but it was prominent in the west Midlands, East Anglia and parts of Wales and, on barley, in the south-west.

Last (*Ann. appl. Biol.* 1957, **45**, 1-10) observed that earlier sowings of spring wheat and barley had less mildew than later sowings. Glynne (*Pl. Path.* 1959, **8**, 15-16) attributed reduced incidence of mildew in plots at Rothamsted to extra potash. On plants being grown under glass for experimental work with yellow rust, Doling and Hepple (*Nature, Lond.* 1959, **183**, 622) obtained control of the mildew without any effect on the incidence of the rust. The effect of mildew on yield was being studied by the N.I.A.B. in conjunction with the N.A.A.S.

Glume Blotch (*Leptosphaeria nodorum* Müller) was of no particular importance in any year except 1958. It was then the fungus disease most

commonly affecting glumes in the East Midland Region: many severe attacks were seen throughout the Region particularly on the heavier soils. It was frequently associated with *Fusarium nivale* in seed infection. With *Fusarium* it was involved in pre-emergence failures when seed from the 1958 crop was sown after treatment with a fungicide based on quintozene (see p. 10). In a trial in the same Region, Banco seemed to be less severely infected than other cultivars, while Koga II was particularly heavily attacked. Discoloration of ears occurred very commonly in southern England. Twelve acres of cv. Atle in Sussex, and 6 acres of cv. Banco in Kent, were affected throughout. In Devon and Cornwall, this *Septoria* disease was very prominent and was undoubtedly responsible for rather low yields and poor quality grain. In many crops the fungus was present on leaves, sheaths and stems in quantity as well as on ears and grain. In one crop of cv. Cappelle Desprez which yielded only 12 cwt/ acre, *S. nodorum* was the principal pathogen: an adjacent crop of cv. Atson grown under identical conditions produced 30 cwt/acre. On several sites in these counties, leaves of cv. Koga II were seen to be very susceptible to the fungus: the tips of the leaves, including the flag leaves, were characteristically tattered as the result of interveinal breakdown through fungal invasion. *S. tritici*, though present, was frequently swamped by *S. nodorum*. Doling (*Pl. Path.* 1961, **10**, 24-7) assessed the severity of glume blotch on cultivars.

In most of the years, **Leaf Spot** (*Septoria tritici* Rob. apud Desm.) was recorded in a few crops only, in the southern half of the country. It was general on the lower leaves of winter wheat in Anglesey in 1957, and present in crops in Devon and Cornwall in 1958, though frequently swamped by *S. nodorum*. Lesions on the leaves and sheaths led to death of plants and some thinning in a crop of cv. Flamingo in Suffolk in 1960.

It happened that the two wet years, 1958 and 1960, especially the former, were those in which **Take-all** (*Ophiobolus graminis* (Sacc.) Sacc.) was most prominent. In the other years, take-all was frequently met with wherever cereals were grown and common in many places, as one would expect, but not particularly damaging.

However, 1957 was described as a take-all year in the east Midlands, with early development and many heavy attacks. The attack there was said to recall the outstanding country-wide epidemic of 1948, and in some fields a break from cereals of a year had failed to eliminate it. Though rarely harmful, the disease was also distinctly above average in the South-eastern Region. A feature of the season in the south-east generally, was the prevalence of stunted plants with thin ears blackened by moulds. While take-all helped to account for some of these cases, it was often absent or slight, and drought followed by very heavy rainfall was thought to be the most likely explanation. Losses due to take-all occurred exceptionally early in the Wye Sub-Region; the disease had been confirmed in a few fields as early as April.

Most districts had appreciable amounts in 1958 and many outbreaks were severe. Particularly in the east, south-east, Yorks and Lancs and the west Midlands, incidence was noticeably higher than usual. In places the attack was especially heavy later in the season.

A feature of 1959 was the lack of damage to the crowns of affected plants: dry soil conditions appeared to have prevented attack on the crown, though moisture below had allowed root infection. The East Midland and South-

eastern Regions both reported this effect: it was sometimes difficult to distinguish from the results of drought. In the south-east, the hot, dry conditions of that year aggravated root troubles, and more damage than one might have expected was caused by relatively small amounts of *Ophiobolus*.

While take-all was frequently noted in most areas in 1960, and indeed the west Midlands had more than for several years, while eastern and south-eastern counties had more than usual amounts, the disease was not normally serious. The low incidence in the east Midlands in 1961—well below normal—was possibly a reflection of the big reduction in the acreage of winter wheat owing to the difficult sowing conditions in 1960. In the South-eastern Region, areas with ears of poorly developed grain were present in many wheat crops, both winter and spring: although typical of take-all, the condition was often attributed to heavy and unusually late applications of nitrogen, as *Ophiobolus* was not always present.

During these years there were one or two striking examples of heavy attacks on land not known to be used for cereals before, or not for a very long time. For instance, in the east Midlands in 1957, a crop of wheat—the first after restoration from open-cast mining—was severely damaged: four other similar attacks had previously occurred in the Region. Explanation was difficult: it was thought that fields scheduled for mining might tend to be over-cropped with cereals while inoculum could survive in the anaerobic conditions in the heaped and compressed top soil. Although weed grasses on the surface of the heaps might play a part in sustaining the fungus, this would hardly account for the failure of such large areas. In 1961 the fungus was confirmed in cv. Cappelle Desprez wheat growing on Norfolk coastal marshes ploughed up for the first time in autumn 1960: the specimens examined were quite badly affected. This phenomenon parallels that in newly-drained polders in the Netherlands, for which an explanation, involving root infection by ascospores in the absence of the normal soil microflora of cereal fields, was put forward by Brooks (*Trans. Br. mycol. Soc.* 1965, **48**, 237-48). In some of the examples, infection was confirmed on grass weed hosts such as bent-grass, couch or Yorkshire fog.

In the east Midlands in 1960 and 1961, it was observed that crops in which the use of certain weed-killers had checked growth had also suffered bad attacks by *Ophiobolus*. Salt (*Rep. Rothamsted exp. Stn, 1961*, 113) suggested that as weedy fields are those with a history of cereal cropping and are, therefore, liable to have take-all, no correlation need be postulated: he obtained no effect on take-all with three herbicides in experiments.

Earlier work at Rothamsted on the effect of nitrogenous fertilizers, applied at different dates, on take-all, eyespot and yield of winter wheat, was continued by Salt both on the heavier soil of Rothamsted (*J. agric. Sci.* 1957, **48**, 326-35), and on the light sandy loam of Woburn (*Ann. appl. Biol.* 1959, **47**, 200-10) where timing of application was found to be much more important. The earlier papers had also considered the effect of alterations in the seed-rate, an aspect later studied by Glynne and Slope (ibid. 187-99) along with the effect of previous crops in the rotation and of nitrogen. Investigations on take-all in relation to rotations continued at Rothamsted (see annual reports).

Gregory and Stedman (*Trans. Br. mycol. Soc.* 1958, **41**, 449-56) trapped ascospores from above the stubble of a wheat crop bearing perithecia of *O.*

graminis and studied the peak rate of liberation of the ascospores in wind-tunnel tests. The occurrence of ascospores of the fungus was clearly associated with rain.

Slope, Last and Bardner (*Rep. Rothamsted exp. Stn, 1961*, 111) found that aldrin, dieldrin and heptachlor decreased infection of wheat by take-all in pots and in winter-sown outdoor plots in the early stages of the crop. A later report indicated that the effect in plots had disappeared by spring.

Willetts (*Trans. Br. mycol. Soc.* 1961, **44**, 504-10) compared isolates of *O. graminis* and *O. graminis* var. *avenae* in cultural appearance and pathogenicity. He recorded what was believed to be the first record of the short-spored form of *O. graminis* producing perithecia in the field. Turner (*J. gen. Microbiol.* 1957, **16**, 531-3) studied the amino acid requirements of *O. graminis* and its oat strain and (*J. exp. Bot.* 1961, **12**, 169-75) discussed an enzymic basis for pathogenic specificity of *O. graminis*.

Eyespot (*Cercosporella herpotrichoides* Fron) seemed to be below normal in most places in 1957. While there was quite a lot in crops in 1958 it was not an exceptional year on the whole though eyespot was widespread in some eastern counties and often severe. It was more noticeable than usual in Lincs, Cambs, Beds and I. of Ely; and in Norfolk where some outbreaks were serious, it was widespread on skirt soils and silts but slight on the lighter soils. Also the east Midlands had more than in the two previous seasons but lodging was rare. In one of several wheat crops infected in Worcs, eyespot was killing the outer tillers in May. Little trouble developed in 1959, while in 1960, only in the east Midlands was infection of any consequence, except for local severity in Yorks and Lancs. There was less than usual in 1961 both in the east and east Midlands and little was seen elsewhere except perhaps in the west Midlands.

In general, eyespot appears not to have been of great importance in these five years. Partly this may be due to the weather. In each year there was a dry period in the spring which may have retarded development. In 1957, April was exceptionally dry and the next two months moderately so. May was particularly dry in 1959 and March unusually so in 1961. There were dry months too in the springs of 1958 and 1960. Another factor was the widespread use of cv. Cappelle Desprez winter wheat. Though infected, it displayed a considerable resistance to lodging. In a cultivar trial in Lincs in 1958, 30 per cent of the tillers of Cappelle Desprez were infected and lodging was slight, while in other cultivars 80 per cent of the tillers were infected and the plots were virtually laid. Among cultivars which did not show up well against eyespot in comparison to others were Marsters 57, Banco and Milfast; and also Artois Desprez was noted as very susceptible in the east Midlands. There were one or two instances of very severe lodging with cv. Svenno.

Current knowledge at the beginning of the period was reviewed by Glynne and Salt (*Rep. Rothamsted exp. Stn, 1957*, 231-41). Doling and Batts (*Pl. Path.* 1960, **9**, 115-8) studied the effect of previous cropping on eyespot in winter wheat and found grain yields to be considerably affected by severe eyespot. Glynne and Slope (*Ann. appl. Biol.* 1959, **47**, 187-99) and Salt (*Pl. Path.* 1959, **8**, 59-61) also studied rotations in relation to eyespot. Salt compared the effect of nitrogen applied on different dates and on different soils (*J. agric. Sci.* 1957, **48**, 326-35; *Ann. appl. Biol.* 1959, **47**, 200-10). Macer

(ibid. 1961, **49**, 152-64) found *C. herpotrichoides* to be a poor competitor and unlikely to colonize straw in the soil and (ibid. 165-72) that the fungus survived in buried straw with virtually no loss of vitality for the three years of his tests. Gregory and Stedman (*Trans. Br. mycol. Soc.* 1958, **41**, 449-56) could trap conidia of *C. herpotrichoides* only during rainy periods.

Sharp Eyespot (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was noted in a few crops, in the north only, in 1957. It was, however, more than usually prevalent in the west Midlands and south-east in 1958. The disease was frequent in Yorks and Lancs that year and occasional in other parts of the country. Infection was common in most cereal crops in the west Midlands in 1959 with an apparent increase in incidence, but elsewhere was apparently not in evidence. In 1960, sharp eyespot attracted notice in several Regions. It was very prevalent in the east Midlands particularly in crops following old permanent grass or long leys: yields seemed not to be affected in spite of infection in a high proportion of tillers in some instances. Attack was very common on all cereals in the west Midlands and, in some fields of cv. Cappelle Desprez, early lodging was serious: the disease was often severe where cereals followed potatoes. Infection was commonly seen on samples in the Eastern Region and was possibly more noticeable than usual in crops. Several outbreaks were noted in different parts of the country in 1961, but the fungus was of little consequence. **Root Rot,** due to *C. solani*, was noted in the odd crop only. In an outbreak in War, the great amount of *Rhizoctonia* present on, and confined to, the roots caused concern about *Ophiobolus* though this was not present to any extent, nor were the stems blackened. Acid soil conditions may have predisposed the plants to attack.

It has long been recognized that species of *Fusarium*, mainly *F. culmorum* (W. G. Smith) Sacc. and *F. avenaceum* (Fr.) Sacc. also *F. nivale* (Fr.) Ces. (*Calonectria nivalis* Schaffnit) are associated with **Brown Foot Rot,** in which rotting of cereal roots and stem bases leads to premature ripening or failure to ear. Species of *Fusarium* are very common invaders of cereal stubbles and it seems that, perhaps under certain conditions unfavourable to the growing crop, they can become prominent earlier in the summer. In some years they are frequent on the browned roots and stem bases of stunted plants but their significance is not clear. Subsequent invasion of the ears, **Ear Blight**, is often a feature of wet seasons, and following a wet harvest trouble with seedling blights may be experienced.

1961 was the outstanding year for brown foot rot, but judging by reports it was of little consequence in any of the other years except in the extreme north in 1958 and 1960.

In 1958 it appeared in crops throughout the Northern Region; ripening was premature and yields from some extremely promising crops were disappointingly low. Many attacks occurred in the Region in 1960 with cvs. Koga II and Jufy I severely affected; the presence of *Fusarium* was thought to be leading to some low yields. Though frequent in Yorks in 1960, little serious harm was done and only in a few attacks did ear blight develop. In some samples from the west Midlands that year, many straws were browned at the base and *Fusarium* was sporulating at the first node above ground level.

During a survey of fusarium foot rots in cereals in Yorks and Lancs, very little was found during 1957, 1958 and 1959 and apart from two attacks by *F. nivale*, one on oats, only *F. culmorum* and *F. avenaceum* were detected.

An outstanding feature of 1961 was the amount of brown foot rot in cereals all over the country. In the spring, many soils were still wet, which may have encouraged the condition, and in some places the number of recent wet harvests may have helped to build up infection. Whiteheads were scattered through fields in the Yorks and Lancs and East Midland Regions and in the latter, *Fusarium*, which may have followed injury from some other cause, spored freely at the lowest node of prematurely ripened tillers, which broke off readily at this point.

In the Eastern Region nearly every wheat or barley field examined was affected but except in the silt soils, lodging and yield losses were not serious. Especially affected were the Norfolk marshland and the very light Norfolk sands where drought and the effects of the fungus together was often devastating. Yields were thought by local advisors often to have been reduced by up to a half. In the west Midlands, where this was the predominant foot rot, there was up to 10 per cent infection in some fields by July. In the South-eastern Region the sudden prominence came after a virtual absence for several years.

In eastern counties nearly all the infection was attributed to *F. culmorum*, while in the south-east this fungus and *F. avenaceum* were found in affected straws but *F. nivale* was not. Reports from elsewhere did not indicate the species involved.

Spring wheats appear to have suffered badly and Jufy I was sometimes cited as being very commonly, or indeed the main cultivar, attacked, perhaps merely an indication of its popularity. Many crops of cv. Cappelle Desprez were affected.

Seedling blight attracted attention in some eastern counties in winter 1958/59. Winter wheat crops, mostly Cappelle Desprez, failed on several farms in the Brigg district of Lincs in October 1958. Although germination had seemed satisfactory, many seedlings were badly distorted and twisted and did not emerge from the soil, so that stands looked very poor and backward. *Fusarium* spp., including *F. nivale*, were frequently associated also *Septoria nodorum*. In some outbreaks, *Calonectria nivalis* Schaffnit, which is the perithecial stage of *F. nivale*, later developed on many wheat heads. More failures took place in the Fen and Grantham area of Kesteven (Lincs). In every instance a seed dressing based on quintozene had been used, and in a small trial at Shardlow, J. S. Knapman found that an organomercurial seed dressing was much more effective in controlling both *Fusarium* and *Septoria* than was quintozene. Poor emergence due to seedling infection continued to be reported from the east Midlands in the early months of 1959 and, while spring wheat was affected, the main trouble was in oats.

In 1958, the ears of many crops in the Eastern Region were contaminated by *Fusarium* spp. at harvest time. Trouble, similar to that experienced in the east Midlands, occurred in late 1958 with some sowings from this harvest when quintozene, and in a few instances an organomercurial, had been used to treat the seed. However, in the east most of these crops later filled out well in spite of seedling blight and the eventual yield loss was judged to be very small. The summer of 1959 was dry and the harvest presumably of better quality: seedling blight was not troublesome in either Region in the following growing season. From examination of samples at O.S.T.S., *F. nivale* and

S. nodorum appeared to be widespread in winter and spring wheat seed (annual reports of N.I.A.B. for 1960 and 1961).

In the South-western Region, *Calonectria nivalis* was quite common in 1959 on leaf sheaths in wheat crops and was associated with blackening of the culms.

In June 1960, Professor Tyler of Cornell University diagnosed **Cephalosporium Stripe** (*Cephalosporium gramineum* Nisik., Mats & Yamanti) on winter wheat plants from Broadbalk field, Rothamsted. The fungus was isolated from leaves, nodes and internodes. Infection has since been found on other fields at Rothamsted. Slope (*Pl. Path.* 1962, **11**, 160) has described the disease and reported on pathogenicity tests. The stripe had not previously been recorded in England, though it had been found frequently in wheat, oats and barley in Scotland in recent years (Gray and Noble, *Pl. Prot. Bull. F.A.O.* 1960, **8**, 46). First recorded in Japan, it is common in parts of the U.S.A. and sometimes serious there. Attacks in England were of no consequence in these years, but more recent experience has shown that infection can become very extensive in a crop. In the past, the effects of the fungus may have been overlooked or confused with other disorders; its potentialities were still unknown.

Glynne and Moore (*Pl. Path.* 1961, **10**, 168) reported the occurrence of *Melanospora damnosa* (Sacc.) Lindau associated with *Fusarium culmorum* on wheat, oats and barley in Herts; and on oats and barley in Sussex and Hants respectively.

White Foot Rot (*Gibellina cerealis* Passer.) which has only been found at Rothamsted, though it has occurred there regularly since 1935, was more common there in 1961 than at any previous time (*Rep. Rothamsted exp. Stn, 1961*, 110).

The incidence of **Loose Smut** (*Ustilago nuda* (Jens.) Rostr.) fluctuated a little but, while present in many crops throughout the country each year, the disease generally remained of little importance though experience in 1959 gave some disquiet. Parts of the Eastern Region had more than usual in 1958 though it was mainly not severe. Smut was particularly noticeable also, in both the Northern and East Midland Regions in 1959, and up to 6 per cent of heads were affected in some crops in the latter. There were many reports of infection in cv. Hybrid 46 in Oxon. A feature of 1959 was the amount of smut in cv. Cappelle Desprez, formerly regarded as highly resistant. Figures supplied by the N.I.A.B. showed that 88 per cent of the crops of this cultivar, inspected in the Cereals Field Approval Scheme, had smut, and 31 per cent of them exceeded the current standard of 1 in 5,000. The standard had been adopted that year in place of 1 in 10,000 because of the obvious increase in the disease. Some Regions commented on increased amounts in this cultivar in the two following seasons, but infection percentages were low. The race on Cappelle Desprez differed from races known previously in this country. Of wheat crops generally, in 1959, 19 per cent of those inspected had smut. It appears that considerably more was present in 1959 than for some years: the summer of 1958 had been wet and cool. Amounts seemed more than normal in the west Midlands in 1960. Over the country generally, incidence was lower in this year than in 1959 but in a field of Hybrid 46 in Oxon, nine smutted heads were counted per sq. yd. In 1961, loose smut appeared to be somewhat less in evidence than usual.

Batts and Jeater (*Ann. appl. Biol.* 1958, **46**, 23-9) showed that, with susceptible cultivars, an embryo test can determine the number of infected plants which will develop in the crop grown from the seed. They followed the development of the fungus in susceptible wheats (*Trans. Br. mycol. Soc.* 1958, **41**, 115-25), while Mantle found that it persisted in the growing point (ibid. 1961, **44**, 546-8). Mantle (*Ann. appl. Biol.* 1961, **49**, 510-4) found that 41 wheat cultivars differed widely in susceptibility to three races of *U. nuda*. In connection with determination of reaction of cultivars he found (ibid. 692-703) that vernalization of infected seed of field-resistant wheats led to unusual host-parasite reactions. This worker detected no significant effect by gibberellic acid on the development of mycelium of the smut within susceptible wheat plants in the glasshouse (ibid. 506-9): he also investigated anatomically a seedling wheat reaction to the smut, characterized by growth inhibition and leaf chlorosis (*Trans. Br. mycol. Soc.* 1961, **44**, 529-45).

With the widespread use of organomercurial seed dressings, **Bunt** (*Tilletia caries* (DC.) Tul.) is no longer of importance. It was occasionally seen in Norfolk and Essex in 1957 but hardly any other reports from crops or seed samples were received during the five years. Marshall reported on samples of commercial wheat seed examined for bunt at O.S.T.S., Cambridge from 1918 to 1957 (*Ann. appl. Biol.* 1960, **48**, 34-8). Since the high level of infection found in 1921 (33 per cent of samples), incidence had decreased rapidly to a steady level of less than 1 per cent with bunt. In 1957 no bunt spores were found in the 122 samples examined at O.S.T.S.

Apart from in the odd, appreciably contaminated sample, **Ergot** (*Claviceps purpurea* (Fr.) Tul.) appeared only in light amounts in wheat; as in Wilts in 1957 and in Dorset and Wilts in 1959.

In the east Midlands in 1958, several reports concerned samples of grain, particularly cv. Koga II, producing ill-effects in poultry: usually, egg production dropped markedly. When plated onto agar all these samples were found to be heavily contaminated with *Epicoccum purpurascens* Schlecht.

Black Mould (mainly *Alternaria* and *Cladosporium*) was very common on the ears of cereals in 1957 and 1958 in much of the country. Some part of this was associated with take-all on the roots but much was not. Black mould due to *Cladosporium herbarum* (Pers.) S. F. Gray was reported (Böning, *Pflanzenschutz*, 1957, **9**, 115) to be remarkably prevalent on cereals in Germany in 1957, and an etiological connection between it and take-all was postulated. In south-east England in 1957 whole fields were sometimes affected and those receiving heavy nitrogen suffered most: in one field where a part only had been given extra nitrogen a clear line of demarcation was apparent between the two areas. Secondary moulds were prevalent again in wheat crops in the south-east in 1960, while 1961 saw particularly early and severe mould in some Eastern Region cereal crops, much being associated with brown foot rot but some with unfavourable growing conditions. Ears of unharvested wheat were often extensively blackened in the Evesham Area in 1961 and grain samples discoloured.

The occurrence of **Barley Yellow Dwarf** virus in cereals is discussed under barley and oats. Although the virus was found on wheat, specific reports on this host were few and the virus was apparently of much less consequence on wheat than on oats and barley. The leafhopper transmitted **Wheat Striate Mosaic** virus appears not to spread rapidly in the field

Watson, *N.A.A.S. q. Rev.* 1959, No. 43, 93-102). It was recorded in several crops in the west Midlands in 1959. In an N.I.A.B. trial of winter wheats in Herefs it was confirmed in all cultivars but appeared to be more common on Viking. It was noted as widely distributed throughout the odd crop in the west Midlands and Norfolk. Slykhuis and Watson (*Ann. appl. Biol.* 1958, **46,** 542-53) had reported finding a virus similar to wheat striate mosaic affecting up to five per cent of plants in English wheat fields in 1956: other hosts included oats, barley, rye and ryegrasses. Plants with similar symptoms were found on farms in several eastern counties but how long it had been present in this country was not known. Similar symptoms had been seen previously. Studies on transmission of the virus by leafhoppers were made by Watson and Sinha (*Virology*, 1959, **8,** 139-63).

Brown Neck (non-parasitic), in which a dark stain appears below the ear was very prevalent in some Regions in 1958, and melanism of exposed parts of the internodes was also common in the west Midlands. Brown neck was present to some extent in all crops seen in N. Wales in 1959, being extensive in some, and there were reports from some parts of the country in 1957. Brown staining and brittleness of the lowest internodes was a common feature of all cereals in the Eastern Region in 1957. **Loose Ear** (non-parasitic) was reported occasionally. In two affected crops in War, cattle had previously strayed into the field and, in another, sheep had done so. Loose ear in several crops in the south-west in 1961 was probably associated with damage by animals grazing the fields earlier.

Grey Leaf (manganese deficiency) was serious in some crops in Norfolk in 1958, being widespread on organic soils and said to be worse than usual. Work on the control of this disease with manganese sulphate was done in Ireland (Walsh and McDonnell, *J. Dep. Agric. Repub. Ire.* 1956-7, **53,** 44-52). **Magnesium Deficiency** was also worse than normal in Norfolk in 1958.

A form of **Copper Deficiency** was identified by the Soil Chemistry Department of the South-western Region in 1961. The symptoms had been seen in some cereal crops in Wilts over several years. The following has been taken from information supplied by Dr. D. B. Davies:

Both spring wheat and spring barleys are affected but symptoms are different in the two crops. In wheat, affected plants appear exceptionally green and vigorous until grain development commences: this is atypical of normal acute copper deficiency symptoms. Subsequent to their formation the grains do not swell, so that the ear remains thin and 'rat-tailed'. The plant assumes and retains an overall dark olive green colour instead of ripening normally and melanin develops in the cells of the stem. At harvest, grains are either absent or dark and shrivelled: yields are therefore much reduced. The symptoms on barley are discussed on p. 16. The deficiency occurred on some soils of the upper and middle chalk and was invariably associated with soils of high organic matter and low available copper content. At least 1,000 acres of cereals were affected in Wilts in 1961 and it was thought that a considerably larger area might be involved. Control of the disorder was obtained by copper oxychloride sprayed at an early stage.

Reports of **Chemical Injury,** for example by organomercurial seed dressings often in combined formulations with BHC, and by hormone weedkillers, were few. Hewett (*Nature, Lond.* 1959, **183,** 1600) showed that a mercury/BHC seed dressing could be responsible for reduced germination

of wheat. Various forms of **Weather Injury** were reported. In some areas and years, effects on the foliage such as tip withering, yellowing and scorching were attributed to low temperatures or frost injury. Frost was believed to be responsible for a marked stunting in June, with a water-soaked appearance of the stem bases, of half a crop in Sussex in 1958. Poor or partial filling of ears was variously associated with frost, heavy rain at a critical stage of flowering, or drought. A colour banding of cereal seedlings was shown by Wilcox to be related to deep sowing (*Pl. Path.* 1959, **8**, 34-5).

Barley

These five years saw a considerable increase in the acreage of barley, a crop which had been gaining in importance through the 1950's. The 1961 harvest of over 3 million acres was the largest ever recorded in this country (Bell, *Agriculture, Lond.* 1961, **68**, 245-7).

The 1961 season was notable for the general occurrence of **Yellow Rust** (*Puccinia striiformis* Westend.) on the spring crop: this had not occurred for about a decade. However, infections were only slight. **Black Stem Rust** (*Puccinia graminis* Pers.) was reported only from Som and Oxon. **Brown Rust** (*Puccinia hordei* Otth) had been attracting attention. In 1960, attacks were severe in some crops in the east Midlands, and infection became common in Yorks and Lancs, and in the Eastern Region. In the previous year the rust was severe in Dorset in September. In 1961 a small survey of barley crops in the Teign Valley, Devon, revealed brown rust to be widespread though, in general, light. The general pattern of outbreaks of **Powdery Mildew** (*Erysiphe graminis* Mérat) on barley was similar to that on wheat and is discussed under that host. Most infection developed in 1957; fair amounts were noted in 1958 and 1960 and rather less in 1959 and 1961. The effect of mildew on yield of spring barley was studied in N.I.A.B. trials from 1957-60 (Large and Doling, *Pl. Path.* 1962, **11**, 45-57). Buxton, Last and Nour (*J. gen. Microbiol.* 1957, **16**, 764-73) reported a decrease in the pathogenicity of the barley mildew by ultra-violet irradiation. Other work on mildew is mentioned under wheat.

Leaf Stripe (*Pyrenophora graminea* Ito & Kurib.) was very rarely seen and **Net Blotch** (*Pyrenophora teres* Drechsl.) was of no perceptible importance, but **Leaf Blotch** (*Rhynchosporium secalis* (Oud.) Davis) was noticeable in a number of crops in most years. Leaf blotch was very much in evidence in the extreme south-west in 1958. The 1960 season saw a fairly severe recurrence of the disease in the South-eastern Region after it had virtually been absent for several years. It was especially prevalent and severe in the south-west in 1961, though in Devon and Cornwall attacks were slight. Owen (*Trans. Br. mycol. Soc.* 1958, **41**, 99-108) confirmed that British isolates of *R. secalis* show strict host specialization.

Take-all (*Ophiobolus graminis* (Sacc.) Sacc.) was reported from many parts of the country but was less significant than on wheat. For the general account of the disease on cereals see p. 6. As with wheat there seemed to be little serious trouble from **Eyespot** (*Cercosporella herpotrichoides* Fron), except perhaps in 1958, possibly as each spring had at least one dry period. **Sharp Eyespot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) on cereals is discussed under wheat (p. 9). Outbreaks of **Foot Rot** due to

C. solani occurred in 1957 in Yorks, and in 1961 in Cards where about 1/10 of a 6-acre crop was affected. The purple tinge which can develop on leaves of infected plants, giving rise to the name 'purple patch', was seen in three Norfolk crops in the spring of 1961: two of these were badly affected. Patches of retarded cv. Rika plants were noticed in a 20-acre crop in Norfolk: the root systems were much branched and root tips had died.

Barley suffered similarly to wheat from **Brown Foot Rot** (*Fusarium* spp.) in the exceptional year of 1961, and reports came from many parts of the country. In other years it was mainly found in the north. **Ear Blight** (*Gibberella zeae* (Schwein.) Petch) was commonly found in mid-Wales in 1960. It was heavy on farms in Pemb and it was reported that pigs (weaners) fed with the grain had suffered from severe scouring and some had died. A slightly affected sample from Yorks W.R. in 1958 may have been connected with the death of pigs.

The occurrence of *Melanospora damnosa* (Sacc.) Lindau on barley is mentioned on p. 11.

Loose Smut (*Ustilago nuda* (Jens.) Rostr.) was chiefly of little consequence in 1957, but was present, particularly in Scandinavian cultivars, in most parts of England and Wales. In the extreme south-west, several attacks in Scandinavian cultivars were severe. In the worst, a count revealed it in nearly 25 per cent of a crop of cv. Herta: in an examination of embryos from the harvested grain, only 1 per cent of infection was detected. Several Eastern Region counties had more than usual in 1958, while attacks were widespread in the South-eastern Region, especially on cvs. Herta and Rika in Oxon. Incidence and severity were noticeably higher in the Northern Region in 1959; and smut was somewhat above normal throughout the Midlands and in the South-eastern Region, also in Cambs but in the east generally, incidence was variable but occasionally heavy. The N.I.A.B. reported that 11 per cent of the barley crops inspected in the Cereals Field Approval Scheme had smut present in 1959. Forty-seven per cent of the crops of cv. Proctor, regarded as very resistant, had loose smut when inspected, and 10 per cent of these exceeded the standard of 1 in 10,000. Cultivar Volla was very badly attacked in some trials that year. Smut was not prominent in 1960 or 1961, though noticeable in the west Midlands and N. Wales in the former year, and common in some places in the latter. There was an interesting outbreak in Essex in 1960 when a field of Rika was drilled in two parts, one part in March, the other in April, and both seed from the same stock. The smut in the latter sowing was many times as heavy as in the former.

Experiments on the optimum time and temperature for control of loose smut by hot water treatment are reported in *Rep. natn. Inst. agric. Bot. 1959*, 23-4. Marshall (*Ann. appl. Biol.* 1959, **47**, 232-9) reported on the incidence of *U. nuda* in commercial seed samples examined by a simplified whole-embryo test at O.S.T.S., Cambridge during 1954-7. While 84 per cent of Scandinavian-bred barley cultivars were infected, with a level of infection up to 19 per cent, only 9.5 per cent of English-bred cultivars were infected, with a level of infection rarely more than 0.5 per cent. Two modifications of the Canadian process of extracting barley embryos for examination for loose smut were discussed by Laidlaw (*Pl. Path.* 1961, **10**, 63-5). Malik and Batts (*Ann. appl. Biol.* 1960, **48**, 39-50) devised an inoculation technique for determining the reaction of barley cultivars which reflected their behaviour

in the field and (*Trans. Br. mycol. Soc.* 1960, **43**, 117-25; ibid. 126-31) investigated infection and development in barley. Gray (*Pl. Path.* 1958, **7**, 14-6) identified races of the smut in Scotland.

At one time, **Covered Smut** (*Ustilago hordei* (Pers.) Lagerh.) was of wide occurrence, but during these five years was hardly noticed. It appeared in several crops in Devon in 1958 and in one, of cv. Carlsberg, infection was at least 10 per cent. Otherwise the disease was recorded only in Caerns, in 1957. A barley crop in Suffolk was seriously affected by **Ergot** (*Claviceps purpurea* (Fr.) Tul.) in 1957, but very few other outbreaks were reported. In 1959, a very small patch of barley plants in a field near Goole, Yorks W.R., was affected by **Snow Mould** (*Typhula incarnata* Fr.). This was only the second time that the fungus had been recorded on barley, the first being described by Croxall and Moore in *Pl. Path.* 1953, **2**, 140. Species of *Penicillium* and *Aspergillus*, present on a grain sample in Berks were thought to have reduced the appetite of cattle and poultry to which the grain had been fed. Other grain moulds are discussed under wheat.

The first virus to be isolated from cereals in Britain was **Barley Yellow Dwarf** virus which was first confirmed in barley collected at Rothamsted in 1954 (Watson and Mulligan, *Pl. Path.* 1957, **6**, 12-14). Though later recorded in the odd plant, the virus seemed not to be of much consequence until 1957 when symptoms appeared much more commonly in spring crops and the disease was found in various parts of the country. As pointed out by Watson (*N.A.A.S. q. Rev.* 1959, No. 43, 93-102), the mild winter of 1956 was followed in 1957 by the earliest and largest spring migration of aphids ever recorded here. Many crops in the east Midlands and mid-Wales, and some elsewhere, showed symptoms. Rather more was seen in 1958 in the Midlands and to the south, and the disease appeared to be widely distributed. In the other years, although widespread in the South-western Region in 1959, and in the East Midland Region in 1961, amounts appeared to be mainly negligible elsewhere. Other details of this virus on cereals generally are given under Oats.

Kassanis and Slykhuis (*Ann. appl. Biol.* 1959, **47**, 254-63) reported some of the properties of the seedborne **Barley Stripe Mosaic** virus. In 1956, symptoms caused by this virus were noticed on leaves of cv. Gloire de Velay barley plants grown by the N.I.A.B. from seed obtained from France; but although many English barley fields were examined for the disease, no infection was found then or since.

Yellowing of leaves in several crops in N. Wales in 1958 was mainly associated with **Nitrogen Deficiency** in such a wet year. Similar symptoms in the south-west in May 1961 could often be attributed to poor root development and nitrogen shortage following the wet spring. In 1958, **Grey Leaf** (manganese deficiency) was seen in several crops in northern districts and was prominent in Norfolk. A condition of spring barley and spring wheat, recognized in Wilts for several years, was identified in 1961 by the Soil Chemistry Department of the N.A.A.S. South-western Region as due to **Copper Deficiency** (see under Wheat p. 13). The symptoms in the two cereals are dissimilar. In barley the first signs appear at heading: delay in ripening is a feature and a lack of lustre as ripening proceeds. Some of the grain fails to develop and this results in an uneveness of the ears while the awns become bleached before harvest time. Melanin is not formed in the stem as it is in wheat. Yields may be reduced by as much as a half or more.

Spring-sown cereal crops in the south-east were badly stunted in 1959 and barley was especially unthrifty: the condition was ascribed to drought, often associated with shallow sowing. Whitening of the tips of the first-formed leaves of seedlings and of ears respectively was sometimes attributed to low temperatures. **Soil Acidity** was said to be the cause of curling of the roots and severe stunting of barley plants at two localities in Som. **Blast** was locally common in Yorks W.R. in 1958. Reports of **Grain Splitting** came from the north and south-west in 1957, sometimes associated with heavy amounts of *Cladosporium* and *Alternaria*. In 1958, following splitting in a cv. Provost malting sample grown in Salop on medium to heavy soil, saprophytic fungi developed when grain was on the germinating floor. According to the maltster, samples of Proctor from the same area were particularly affected but there was no trouble with cv. Plumage Archer. In 1959, reports from Glos indicated that split grains were rather prevalent in Proctor.

Oats

Severe outbreaks of **Crown Rust** (*Puccinia coronata* Corda var. *avenae*) developed in the extreme south-west in 1957 and 1961 and late in 1960, and the disease was common there. The resistant cv. Manod showed up well in cultivar trials in the area in 1961. The rust was occasionally severe in Cards in 1957 and common on all cultivars, except Manod, seen in Cards and Pemb in 1961. Griffiths (*Trans. Br. mycol. Soc.* 1958, **41** 373-84) described the pathogenic reactions of 13 races of the rust, and Griffiths and Carr (ibid. 1961, **44**, 601-7) produced a mutant from race 96 by ultra-violet irradiation and discussed the significance of mutation to the evolution of new races. **Black Stem Rust** (*Puccinia graminis* Pers.) was noted in Wales in 1958, and odd records from the south-west and Wales were received in 1959. Incidence of **Powdery Mildew** (*Erysiphe graminis* Mérat) was similar to that on wheat and is discussed under that host. Most mildew occurred in 1957, while many attacks were severe in 1958 and 1960 but fewer in 1959 and 1961. The common cultivar S172 often suffered badly, but Manod remained virtually free in mid-Wales in 1961 when mildew was very common on all other cultivars. The effect of mildew on yield of spring oats was studied at N.I.A.B. trials from 1958-61 (Large and Doling, *Pl. Path.* 1962, **11**, 45-57).

Although widespread in the South-eastern Region in April 1957, and by July well above average and reported from most counties there, **Leaf Spot and Seedling Blight** (*Pyrenophora avenae* Ito & Kurib.) gave little trouble in England and Wales during 1957-61. These attacks in the south-east were in crops from treated and untreated seed of cv. S172. Occasional outbreaks were noted in most oat-growing areas, usually in the north, the east Midlands and Wales. All counties in mid-Wales very commonly reported seedling blight in 1958. A number of crop failures due to leaf spot in Brecon in 1961 were found to be with untreated seed from a single Scottish source. S172 was the most heavily infected in a winter oat cultivar trial in Wilts. In Dorset, germination was only 50 per cent in a crop of spring oats, cv. Star, and the leaves of seedlings were badly affected by the fungus, mycelium of which was found on the seed from which the crop was grown. Nearly all oat samples submitted for routine tests at O.S.T.S. in 1961 were infected with *P. avenae* and many had over 20 per cent infection (*Rep. natn. Inst. agric. Bot. 1961*, 15).

In an investigation with the Ulster Method (for testing seeds for the presence of the fungus) Malone (*Proc. int. Seed Test. Ass.* 1959, **24**, 179-83) found that agars prepared with several commercial brands of malt extract each gave satisfactory results.

More **Septoria Leaf Spot** (*Leptosphaeria avenaria* Weber) than usual appeared in many crops in Devon and Cornwall in 1958 and it was particularly widespread in a crop of cv. Blenda. Severity was much greater than normal throughout the Northern Region in 1960: leaf spotting became prominent late in July and some crops were badly defoliated. In Cumb a whole crop of cv. Forward was infected. The disease was common in N. Wales in most years but not damaging. The fungus was present in considerable quantity on a 6-acre crop in Devon which had failed almost completely with very little grain development: the failure was attributed to late spraying (growth stage 9.5) with 2, 4-D weedkiller, but it was wondered if the effect of the chemical on the sugar content of the plants might have influenced the activities of the fungus.

Take-all (*Ophiobolus graminis* (Sacc.) Sacc. var. *avenae* E. M. Turner) was common in Wales and the north in 1958 and present in other years. In 1958 this oat strain of take-all occurred for the first time in the South-eastern Region, when a crop of cv. Sun II oats was affected at Carisbrooke I.W. The first record of the fungus from Kent came in 1960, when ⅓-acre of cv. Powys was rendered useless. Apart from those from Wales, the north and the two records from the south-east the only other reports came from Devon where marked loss occurred in a crop in 1958. Willetts (*Trans. Br. mycol. Soc.* 1961, **44**, 504-10) compared isolates of the oat strain and of *O. graminis* in cultural appearance and pathogenicity and provided further support for the separation of *O. graminis* var. *avenae* from *O. graminis*. Turner (*J. exp. Bot.* 1961, **12**, 169-75; *Nature, Lond.* 1960, **186**, 325-6) discussed an enzymic basis for pathogenic specificity of *O. graminis*. An oat crop was badly attacked by **Eyespot** (*Cercosporella herpotrichoides* Fron) in the west Midlands in 1958, but otherwise the disease received no special mention on this host. **Sharp Eyespot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was not specified in any of the reports received. **Root rot** due to *C. solani* was seen in several oat crops in S. and mid-Wales in 1958 and was noted in Cards in 1959.

Brown Foot Rot (*Fusarium* spp.) was quite common in Northern Region counties in 1958 and 1960 and was noticed in 1959 and 1961. Crops of cvs. Sun II and Blenda were badly attacked in some districts in the north in 1960, and yields of several oat crops in a number of places there were thought to have been affected. *Calonectria nivalis* Schaffnit, the perfect stage of *F. nivale* (Fr.) Ces., was extensive in two fields of cv. S172 oats in Worcs in June 1958. The seed was home-saved and untreated, and although the stand was good, the crops lacked vigour and failed to respond to fertilizers. While foot rot was not in evidence, perithecia were plentiful on the leaf sheaths. Brown water-soaked areas appeared where the bases of leaf blades had been invaded, and with the collapse of these tissues, leaves otherwise green lay pendant down the stem. Perithecia in abundance were found on the stems of a number of crops grown from untreated seed in widely scattered parts of the west Midlands, and stands had mostly been reduced because of the extent of infection.

In the spring of 1959, many oat crops emerged poorly in the East Midland

Region due to *F. nivale*, the effects being similar to those already described for wheat that winter (p. 10). The roots were killed and shoots severely twisted and yellowed. Several cultivars were affected, but Blenda, Onward and Forward failed more frequently than did Sun II or black oats. Many of the samples were of new Scottish seed and much of it had not been chemically treated; organomercury dressings on oats did not give the same measure of control as on wheat. *Calonectria nivalis* was unusually common on oats in the West Midland Region in 1959: perithecia were abundant in all oat crops at the E.H.F., Rosemaund in May and, in cultivar trials, secondary tillers and sometimes the main stem were killed. *C. nivalis* was present in 44 per cent of the oat samples undergoing routine tests at O.S.T.S., Cambridge in 1961, but infection was usually at low levels (*Rep. natn. Inst. agric. Bot. 1961*, 51). For the first time, **Snow Mould** (*Calonectria nivalis* Schaffnit) was seen damaging a crop during the winter in the Yorks and Lancs Region late in 1958. **Ear Blight** (*Gibberella zeae* (Schwein.) Petch) was commonly found on oats in mid-Wales in 1960. Parkinson and Chesters (*Nature, Lond.* 1958, **181**, 1746-7) studied rhizosphere populations of *Fusarium culmorum* (W.G. Smith) Sacc. in relation to age of oat plants, and the distribution of fungi in the rhizosphere of oats (*Plant and Soil*, 1959, **11**, 145-6).

The occurrence of *Melanospora damnosa* (Sacc.) Lindau on oats is mentioned on p. 11.

Browning Root Rot (*Pythium* sp.) of cereals has received little attention in this country, and in only one or two instances has it been confirmed in oats. Patches in a crop of cv. S147, drilled in October 1957, were affected in January 1958. An association of *Pythium* with stem eelworm (*Ditylenchus dipsaci*) occurred in plants showing a foot rot in a Wilts crop in 1958. In 1960, H. J. Wilcox reported root and crown rot, associated with a species of *Phytophthora* and/or of *Pythium*, in a 6-acre field of cv. Powys oats in Sussex. Plants were dying in large patches, 20 yd or more in diameter (one was over ¼ acre) in mid-March. A total of 1-2 acres was affected, and within this, 75 per cent of the plants were already dead. In some plants the crowns were rotted and the rot extended into the leaf bases. Oospores (25-33 μm diam.), and oogonia (36-48 μm diam.) were numerous in affected stem and leaf tissues. Oval, non-papillate sporangia, 32-58 x 25-32 μm (mean 47 x 29 μm) were produced from affected leaf bases placed in water. Also frequently found were smaller oospores (18-22 μm diam. with mean 21 μm) of a *Pythium* type. There was a similar effect in a 21-acre crop of Powys in Kent, and here a total of 5-7 acres had died in large patches, and oospores and oogonia, like those in the Sussex outbreak, were abundant. There appear to be no earlier records of *Phytophthora* spp. attacking any of the cereals grown in this country.

Neither **Loose Smut** (*Ustilago avenae* (Pers.) Rostr.) nor **Covered Smut** (*Ustilago hordei* (Pers.) Lagerh.) drew any comment in reports received, except from Wales where the former was noticed once or twice. Gray (*Pl. Path.* 1958, 7, 14-6) identified races of *U. avenae* in Scotland. **Ergot** (*Claviceps purpurea* (Fr.) Tul.) was not mentioned in reports, though death of sheep was associated with the occurrence of what were possibly ryegrass ergots in tailings from barley and oats in the South-eastern Region in 1960.

A few outbreaks of **Halo Blight** (*Pseudomonas coronafaciens* (Elliott) Stevens) were seen in the east Midlands in 1958 and occasional plants were

infected in Wilts that year but otherwise the disease did not come to the notice of advisers. In experiments with seed treatment, Griffiths and Peregrine (*Pl. Path.* 1960, **9**, 10-4) obtained best results with antibiotics, especially streptomycin. They studied about 200 forms of *Avena* for reaction to halo blight, and found that none of the more popular European cultivars showed high resistance (*loc. cit.*).

The presence of **Barley Yellow Dwarf** virus in Britain was first confirmed by workers at Rothamsted (Watson and Mulligan, *Pl. Path.* 1957, **6**, 12-4) in the mid 1950's. Its potentialities for spread were first realized in 1957, a season particularly favourable to aphid development. In that year, symptoms were seen in many crops in the east Midlands and mid-Wales and in some other areas; some crops were seriously damaged. In 1958, many severe outbreaks occurred and a scattered distribution was apparent from the Midlands southwards, with widespread symptoms in the south-east and elsewhere. In the Wye Sub-Region, where the disease was believed to be present generally and symptoms were seen in about 50 crops between April and June, severity was greatest at the end of May when up to 80 per cent loss of yield seemed likely in some crops, but by the end of June there was a high degree of recovery. Frequently, oospores of *Pythium* were found in roots of affected plants but the fungus was thought to be secondary.

Similar general field symptoms in cereals were reported from several Regions in 1958. Infected plants tended to occur in patches, a foot to several yards across, often scattered throughout a field. Leaves were purplish-red and the plants stunted, often severely so (e.g. to only 5 or 6 in. tall) especially in oats. Some plants were completely killed. Sometimes the patches were more numerous near woods or hedges bordering the fields. There were indications in the south-east that symptoms were more severe in crops initially poorly supplied with nitrogen but, there was little response by affected plants to nitrogenous top dressing. Most reports were concerned with winter oats notably cv. S172, also S147 and Powys, but symptoms were seen in spring oats such as cvs. Blenda and Sun II.

In the three seasons 1959-61, a few more reports were received and, at times, the virus was seen to be widespread in a few areas but it was very much less evident than in 1958. Joint surveys of recently-emerged winter oats, by the N.A.A.S. entomologists and plant pathologists in the Wye Sub-Region in the winters of 1958/59 and 1959/60, revealed low populations of aphids.

Some isolates of the virus obtained in 1957 seemed to be more virulent than the original isolate obtained from barley at Rothamsted in 1954. Watson and Mulligan compared a virulent with an avirulent strain, including their host range and effects on yield (*Ann. appl. Biol.* 1960, **48**, 559-74) and in relation to aphid transmission (ibid. 711-20).

Ryegrass Mosaic virus was isolated from naturally infected oat plants sent to Rothamsted from Berks by E. Lester (Watson, *N.A.A.S. q. Rev.* 1959, No. 43, 93-102).

Grey Leaf (manganese deficiency) was frequently observed in Yorks and Lancs in 1959, patches often being conspicuous, and in the Northern Region in 1958. Drennan, Berrie and Armstrong (*Nature, Lond.* 1961, **190**, 824) found that soaking oat grains in solutions of manganous chloride can provide the oat crop with the manganese it requires. Vose and Griffiths (ibid. **191**, 299-300) studied the role of manganese and magnesium in susceptibility to

the 'grey speck' syndrome. Work on the control of the deficiency with manganese sulphate was done in Ireland (Walsh and McConnell, *J. Dep. Agric. Repub. Ire.* 1956-7, **53**, 44-52). Yellowing in several oat crops in all counties of N. Wales in 1958 was mainly associated with **Nitrogen Deficiency** due to the wet season. **Iron Deficiency** symptoms, yellowing of the leaf tips with some interveinal chlorosis, appeared in an oat crop in Wilts on land which had been in pasture for 50 years. Plants in irregular patches in a crop in War showed a white interveinal striping and some had died. The patches involved were areas on which sewage sludge had been stacked about eight years before; **Nickel Toxicity** was confirmed by the N.A.A.S. Regional Soil Chemists.

Several crops suffered from **Blast** in the west Midlands in 1961, but the condition aroused few other comments. Empson (*Pl. Path.* 1958, **7**, 85-7) concluded that blast, a withering of the basal spikelets of the oat panicle, is a symptom of lowered vitality at a critical stage and might be expected to arise from a number of causes such as insect attack or adverse weather conditions. Bleaching of oat plants on one Yorks farm was attributed to **Lightning Injury.**

Rye

Brown Rust (*Puccinia recondita* Rob. & Desm. f. *recondita*) was noted each year and was severe in one or two crops, but **Yellow Rust** (*Puccinia striiformis* Westend.) was noted only once. **Powdery Mildew** (*Erysiphe graminis* Mérat) appeared early in the season in N. Wales in 1957: a few other reports were received from Wales and, in 1961, the disease was locally severe in Yorks. In 1957, **Stripe Smut** (*Urocystis occulta* (Wallr.) Rabenh.) was noted on three plants at the N.A.A.S. Regional H.Q., Bristol—a new record for the Region. **Take-all** (*Ophiobolus graminis* (Sacc.) Sacc.) was recorded occasionally in Wales. Severe seedling blight was caused by *Calonectria nivalis* Schaffnit in demonstration boxes of rye at the N.A.A.S. Regional H.Q. of the E. Midlands in 1958. A sample from Holland (Lincs) was appreciably affected by **Ergot** (*Claviceps purpurea* (Fr.) Tul.) in 1957; otherwise only traces were noted in an odd crop in the east in 1960. Inoculation studies by the N.A.A.S. plant pathologists at Bristol showed that isolates from Yorkshire fog and timothy can infect rye. The incidence of ergot in commercial seed samples of cereals submitted to O.S.T.S., Cambridge during 1918-57 was recorded by Marshall (*Ann. appl. Biol.* 1960, **48**, 19-26); rye samples were more frequently contaminated than wheat or barley samples.

Maize and Sweet Corn

Rust (*Puccinia sorghi* Schw.) was noted only once, on maize in Herefs in 1957; while **Smut** (*Ustilago maydis* (DC.) Corda) appeared on a few plants only in an outdoor maize crop in Surrey in 1957 and was seen on maize in Suffolk the same year. In 1960 a few plants were affected in a sweet corn crop in Surrey. In 1961, maize plants in some 3,000 frames were affected with **Stem Rot** (*Fusarium* sp.) on a nursery in Flints, and a species of *Fusarium* was apparently responsible for poor germination and growth of a 3-acre maize crop in Wilts.

Diseases of Potatoes

A look at the last 20 years shows that in about half, **Blight** (*Phytophthora infestans* (Mont.) de Bary) was sufficiently prominent on a national scale for them to be declared blight years. For the 1950's, we can add 1957 and 1958 to the four blight years 1950, 1953, 1954 and 1956; and another, 1960, was to follow.

The following information on blight is based on the reports from the N.A.A.S., collated at Plant Pathology Laboratory, Harpenden by E. C. Large.

The outstandingly mild 1956/7 winter and the high humidity in March 1957 led to one of the earliest outbreaks recorded to that date on early crops in the Scilly Isles (4 April), Cornwall and W. Devon. Many crops there were affected in April and spraying was often unusually early. Nevertheless, the rest of the earlies' season in 1957 was dry with little development of blight. The maincrop was held back very noticeably; while June was noteworthy for the lack of Beaumont periods, for the first time in eight years. The second week of July was dull, cool and wet. By 15th many areas had had a second flush of periods and outbreaks were forecast on maincrops by the end of July in north-east coast areas and around the Wash, Cumb, Welsh coastal areas and the south-west. For the first time, television was used as a forecasting medium in addition to press and radio. The weather continued dull, cool and wet. A second press notice (29 July) confirmed the warning for the rest of the country. The first blight records on maincrops came from the Midlands in the first two weeks of July and the outbreak began in the fourth week. Development was rapid in August on unsprayed crops, which in most of the main growing areas showed 75-90 per cent stage of blight by the end of the month. This stage was reached 10-14 days earlier in a limited area round the Wash. In parts of Yorks, where the epidemic was unusually early, 1957 became one of the worst years on record. Many complaints of tuber losses were received from the north, and survey results by November in the east Midlands showed an increase of blight in King Edward compared with the previous season. By the end of the storage season, tuber infection was higher than usual in the west Midlands (and seed was similarly affected) and in the south-east. Blight was common in most clamps throughout the Eastern Region but mostly slight to 5 per cent, and, with some exceptions, not causing great loss. In S. Wales, tuber infection was above average, and losses were high in Devon and Cornwall.

In 1958, blight was outstandingly bad. Large (*Agriculture, Lond.* 1959, **65**, 603-8) commented: 'On King Edward in the Fens and parts of the west Midlands it was more like a blight year in the west of Ireland than anything we are accustomed to in the main potato-growing areas.'

On 22 May, first infections on unsprayed earlies were found in Cornwall and the Scilly Isles. At Penzance, cv. Arran Pilot, planted on 2 April, was then infected to the 0.1 per cent stage, with several primary foci of 75-90 per cent. The month following was the wettest June in England and Wales since 1903, generally dull, cool and wet everywhere. Potato crops, previously

backward, grew well, but were still small in the north. Scattered primary foci occurred generally over the country, other than in the north on both earlies and maincrops. First flushes of Beaumont periods came in 7-12 June and 18-21 June, particularly in the Midlands and the Eastern Region. A press notice on 24 June forecast scattered outbreaks on the more forward maincrops, particularly cv. King Edward, in the west Midlands (Ches to Som) and the east (Lincs to Kent) in early July. Observations in the past had shown that June flushes are not usually followed by general outbreaks (within three weeks), but the press notice was issued before a flush of periods on 27-28 June because there were unusually many primary foci in June, and some maincrops, particularly King Edward, were growing rapidly. On King Edward, outbreaks were general by the beginning of July in many counties of the west Midlands, and had occurred in the Fens of E. Anglia. By 7 July, first outbreaks were seen in Lancs (shortly after, in other parts of the north), and outbreaks in King Edward in the east Midlands had been frequent and had occurred in maincrops in Holland (Lincs) and N. Wales. Further development (Fig. 1) during July was variable. Infection in most King Edward crops in the Fens, and in some in the west Midlands, the south-east and the coastal areas of S. Wales reached the 75 per cent stage around the end of July, and in a few in the east Midlands it reached 50 per cent; but the general level in Edwards was 25-40 per cent in the south-east, 15 per cent in the east Midlands, and 5 per cent in sprayed crops in much of the Eastern Region other than the Fens. The epidemic in the Fens had progressed despite intensive spraying, much of it by aircraft.

In Majestic, blight reached 25 per cent in most crops in the Fens, 5 to 10 per cent in the south-east (though some crops were often almost free), but in the east Midlands and south-west only 1-5 per cent, and the Eastern Region other than the Fens, and N. Wales, about 1 per cent. In the west Midlands, where spread in Edwards had often been so rapid, there was little increase in Majestic till the end of July. The 75-90 per cent stage of blight was reached at or before the end of August throughout the country (Fig. 1).

During this epidemic, cv. Ulster Torch had generally shown outstanding resistance.

The general position with tubers in clamps in the 1958/59 winter was of occasional heavy infection from a few areas but, over the country, tuber infection, though common, was not serious on the whole, and was often less than anticipated. In the East Midland Region, the mean percentage of blighted tubers for all crops was 10.5 per cent as opposed to 5.3 per cent in 1957. Of the cultivars involved, King Edward showed 15.6 per cent (7.4 per cent, 1957) and Majestic 2.5 per cent (1.5 per cent, 1957). Infection in the west Midlands was undoubtedly high (varying from 5 to 20 per cent) but crops on light land were less badly infected than anticipated. Up to 30 per cent blight was present in King Edward crops in some counties of the Eastern Region, with Majestic less though some instances of 10 per cent infection were recorded. There were several complaints about blighted seed in Yorks and Lancs but little trouble, apparently, elsewhere.

By way of contrast to 1958, 1959 provided an outstanding summer, one of the best this century. Planting conditions were good on lighter soils, though less so on some of the heavier. It was not a blight year. There were a few Beaumont periods in May and June, mainly in the south-west and S. W.

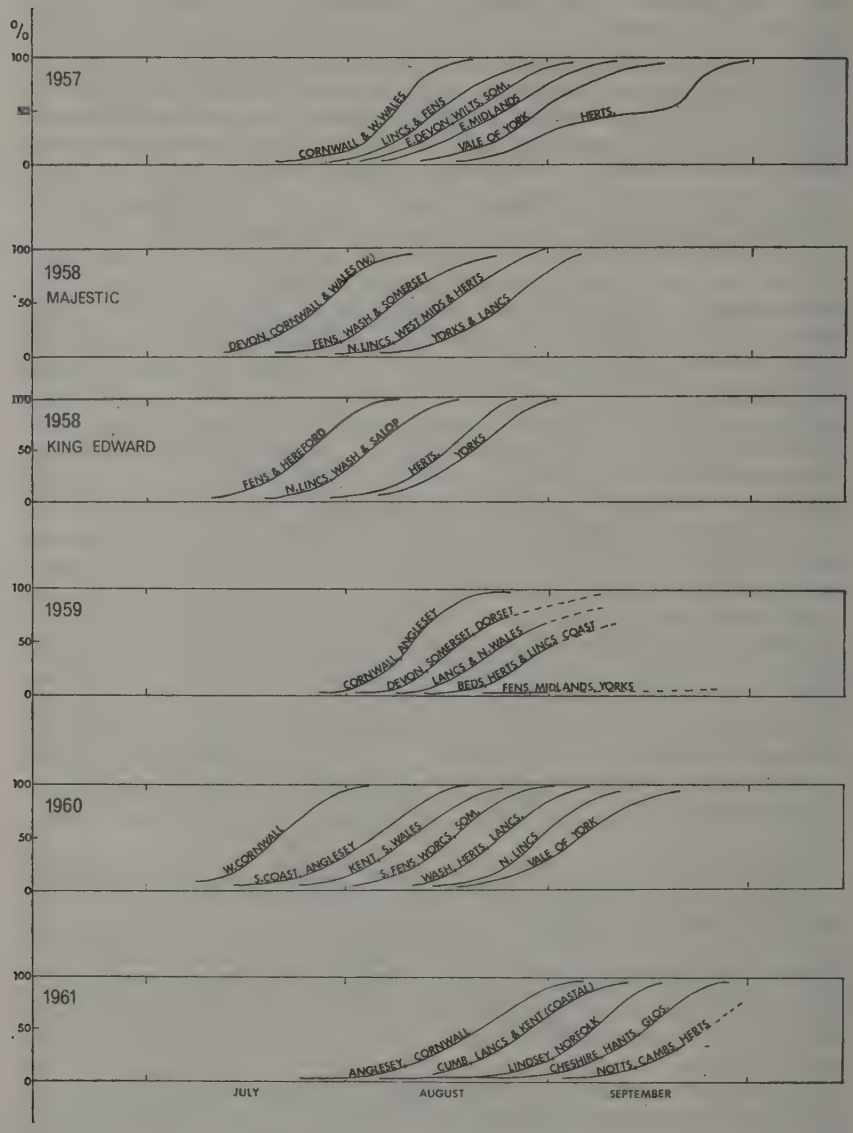

Fig. 1. Potato blight progress curves for unsprayed crops in England and Wales for 1957 to 1961 inclusive. For the 1958 season, the curves for cvs. Majestic and King Edward are shown separately. The interpretation of progress curves for blight has been discussed by Large (*Pl. Path.* 1952, 1, 109-17).

Wales but none of the usual June flushes in eastern and inland areas. By 24 June there was a 4 in. soil moisture deficit in E. Anglia, and the growth of many potato crops was then almost at a standstill. In other areas growth was more variable. The month was notable for a complete absence of reports of primary foci, and, by the end, blight had not been found anywhere in the country except in a trial at Bangor, and in Devon and Cornwall on earlies here and there. The good summer continued and other than in the south-west, there were no flushes of Beaumont periods in July. Some blight was found in Devon and Cornwall during July, but with very few exceptions it was still at the 0.1 to 1.0 per cent stage by 31st. First records on maincrops trickled in from Wales and the south-west, and blight was found on Majestic in Lancs on 23 July and on Redskin, near Carlisle, on 27th. Beaumont periods finally came in profusion between 9-15 August and almost every station was affected: it was the first general flush of blight weather for the year. The only press notice of the year was issued on 17 August: it forecast scattered outbreaks on maincrops in most Regions. Further development, too late to cause loss of yield in most crops, is shown in Fig. 1. The warm dry conditions continued in September and the great majority of the potato crops in the country died down almost entirely unaffected by blight, though often affected by drought. Tuber infection was almost consistently very low everywhere, though lingering blight from mid to late August, plus thundery rain aided tuber infection in mid-Wales and, here, it was not below average. Similarly, consignments of seed tubers were blight-free, or with a low incidence only, in the 1959/60 winter.

With a summer unsettled, cool and frequently wet everywhere, 1960 was another blight year. Primary foci were found at two places in S. Devon near the end of May in Cornwall on 1 June, Pemb on 7 June and elsewhere in Wales later in June, but nowhere else in the country before the end of June. The low levels of tuber blight in 1959 were believed to have led to the dearth of June infection sources. The first major flush of Beaumont periods came between 22-26 June, with much rain in the south Midlands, south and south-east: periods were recorded at all stations except in the north Midlands and north-west. On 28 June, a first press notice forecast outbreaks in forward King Edward crops in western, southern and south-eastern coastal areas, also in parts of Wales and the south-west. First outbreaks were reported in I.W. and Romney Marsh on 4 and 5 July and in a narrow belt along the coast from N. Wales along the south and round to Felixstowe between 4 and 18 July. July was notably cool. Beaumont periods occurred about 9th and 10th in the south and east and in western coastal areas. A press notice, on 12 July, related to all maincrops in East Anglia and round the Wash, all southern and south-western counties: in fact, outbreaks between 18 July and 1 August extended rather further north into the south Midlands than expected. A third notice, on 26 July, forecast outbreaks in the rest of the country, too late for a few west Midland crops. Blight later progressed fairly rapidly, and the 75-90 per cent stage in Majestic and King Edward was reached about mid-August in the south and west coastal areas, a week or so later in most of the south-west, much of the west Midlands, and I. of Ely; and at the end of August over much of the rest of the country. In parts of the east Midlands, Yorks, east Lancs and the north, most crops reached this stage by mid-September.

Tuber blight was well above average in the east Midlands and possibly the most severe attack for several years: levels of up to 80 per cent were reported in cvs. Ulster Torch and Bintje. In the Eastern Region, amounts were variable, with up to 80 per cent in Ulster Torch in Norfolk; many clamps of King Edward and Majestic were also affected but as in the rest of the country, blight was not generally at a serious level.

In 1961, an unusually warm and early spring, a very dry March and plentiful rain in April, led to exceptionally early outbreaks in earlies from mid-April in the Scilly Isles to mid-May in Pemb, Carms and along the whole south coast. By 16 May, the 1–2 per cent stage was reached in many fields of earlies in Pemb and S. Carms. However, dry weather during the next two months arrested blight and there was no general early spread into maincrops anywhere in June. The usual flush of Beaumont periods was absent in June: a partial flush from 9-12 July, and individual periods between 24 June and 9 July at a few coastal stations, and the likely overwintering sources from the 1960 epidemic borne in mind, prompted the issue of a press notice on 12 July. This warning related to forward maincrops in the east Midlands and round the Wash by 26 July and with rain continuing for a few days after 12 July, for the rest of the Midlands and south, Cumb, and coastal districts of Lancs by the end of July. The warning was premature for inland and central parts of the south. A second warning (19 July) forecast first outbreaks for maincrops over most other areas by the first week in August: as persistent rain did not come the forecast proved premature for some central and northern areas. Apart from the west coast, Romney Marsh and a small area in the Fens, blight spread too late to have any appreciable effect on yields. Tuber blight was very variable. In parts of Lancs, Yorks W.R. and the east Midlands it was above average but elsewhere, apart from some occasional severely affected crops, incidence seemed mainly not excessive and even slight.

In 1960 the study by Cox and Large of potato blight epidemics throughout the world (*Agric. Handb. U.S. Dep. Agric.* No. 174) was published. McKay (*J. Dep. Agric. Eire*, 1956-7, **53**, 5-10) looked at 50 years of outbreaks in Ireland.

New fungicides were coming to the fore: Large and Waines (*Pl. Path.* 1961, **10**, 96-100) pointed out that before 1958 almost all applications were with copper products, but that in 1958 dithiocarbamates were in widespread use in trials. By 1960 about a quarter of the applications was thought to be with dithiocarbamates. These authors (*loc. cit.*) examined the extent of protective spraying and haulm destruction in British potato crops during 1952-60: for example, in the extreme blight year of 1958, 310,000 acres were sprayed or dusted in England and Wales (62 per cent of the acreage) whereas in the contrasting year of 1959 the corresponding figures were 210,000 acres (42 per cent). Aspects of blight control were discussed by Brenchley (*Proc. Br. Insecticide and Fungicide Conf. Brighton, 1961*, **1**, 139-44), Evans (ibid. 145-50) and (aerial sprays) Hainsworth (*Commonw. phytopath. News*, 1958, **4**, 38-9). The use of wax emulsions to make leaf surfaces water repellent, and hence to restrict infection by spores, was under investigation (McIntosh, *Rep. Rothamsted exp. Stn, 1961*, 142-3). Trials showed protective sprays applied every year to be uneconomic in the west Midlands even on King Edward (Rosser, *Pl. Path.* 1957, **6**, 77-84). Forecasting schemes for Cumb (1953-57)

and for Jersey (1957-61) were assessed by Croxall, Davey, Gywnne and Johnson (ibid. 1961, **10**, 127-32) and Phillips (ibid. 1963, **12**, 1-6) respectively. Large (ibid. 1958, 7, 39-48) estimated crop losses in England and Wales for 1947-56.

The recent developments in plant breeding were reviewed by Lapwood (*N.A.A.S. q. Rev.* 1960, No. 47, 93-8). Past lack of success with field immune cultivars, due to the variability of the fungus, had aroused interest in field (multigene) resistance at the various U. K. breeding stations. Various aspects of haulm resistance were investigated by Lapwood (*Ann. appl. Biol.* 1961, **49**, 140-51; 316-30; 704-16; *Eur. Potato J.* 1961, **4**, 117-28) and Lowings and Acha (*Trans. Br. mycol. Soc.* 1959, **42**, 491-501). Lapwood and McKee recorded the reaction of tubers of R-gene clones to inoculation with races of *P. infestans* (*Eur. Potato J.* 1961, **4**, 3-13). Accounts of the race situation, in various countries (Black, *Rep. Scott. Pl. Breed. Stn, 1957*, 43-9) and, in Northern Ireland (Doling, *Ann. appl. Biol.* 1957, **45**, 299-303; Proudfoot, *Nature, Lond.* 1959, **183**, 626-7) have been given.

Epidemiology also received attention (Hirst and Stedman, *Ann. appl. Biol.* 1960, **48**, 471-88; 489-517: Clayson and Robertson, *Pl. Path.* 1957, **6**, 123-7). An association between blight occurrence and leaf roll infected plants was shown by Richardson and Doling (*Nature, Lond.* 1957, **180**, 866-7); while sporulation by *P. infestans* on tubers within ridges was noted by Lapwood (*Pl. Path.* 1961, **10**, 40). Boyd (ibid. 1960, **9**, 99-101) found that the proportion of blighted tubers was highest in chat and lowest in ware tubers. Attention was directed to techniques of isolating the fungus (Proudfoot and Sproule, *Eur. Potato J.* 1960, **3**, 155-7) and of culturing it in artificial media (Hall, *Trans. Br. mycol. Soc.* 1959, **42**, 15-20). Race 4 was recorded on petunia and *Datura* (Hirst and Moore, *Pl. Path.* 1957, **6**, 76).

The significance of **Skin Spot** (*Oospora pustulans* Owen & Wakef.) fluctuated, with only one really bad year (1961) in the five. The previous skin spot season was 1954-55. In a 34-year period (seed for planting from 1928 to 1961) six years could be classified as ones in which the disease was prominent.

Noticeably scarce on tubers early in 1957 and in the growing crop, skin spot was fairly common the following winter in Scottish seed arriving in parts of the Eastern Region though only occasionally severe. Some heavy attacks occurred after planting in the west Midlands in 1958, and gappy crops were found in all counties of the Eastern Region. In contrast, the east Midlands had very little trouble. Several crops in other areas emerged unevenly. During the 1958-9 winter, advisers found little to comment upon; a general lack of misses in the field was pointed out by several Regions during 1959. In the next winter, skin spot was fairly common in Scottish seed in Essex but, in the country as a whole, only the odd case of severe infection in seed or in the 1960 growing crop seemed worthy of mention in reports.

In 1961 skin spot was particularly bad. Tubers were severely spotted early in the year and eyes often extensively affected in seed consignments. Chitting was affected in consequence. In the east Midlands almost all eyes were killed in a big proportion of seed in a number of Scottish consignments, and reports from other Regions quoted some very heavily infected batches. Symptoms on seed in the Eastern Region developed unusually late in the spring, judged by the lack of enquiries and specimens until April. Through-

out most of the country, many crops were gappy or backward and, in Yorks and Lancs, some crops from both Scottish and English seed were ploughed up. Gaps often amounted to 25 per cent in the Northern Region. Both King Edward and Majestic commonly featured in reports. In the Midlands, physiological dormancy appeared to play a part in unsatisfactory crop growth but there was no doubt that *Oospora* was a major factor in losses.

The significance of skin spot in seed stocks of King Edward about to be planted, and later in growth, in parts of Scotland in 1959, 1960, and 1961 was studied by Boyd and Lennard (*Pl. Path.* 1962, **11**, 161-6), who confirmed little infection in 1959 and 1960 and relatively high amounts in 1961. After studying records in both England and Scotland for 1927-60 they found it reasonable to relate a year when skin spot is severe, to above average rainfall over the lifting period in the seed-growing areas. They suspected also that when subsequent autumn and early winter temperatures are below average, incidence will be increased. The weather in the autumn of 1960 was exceptional in Scotland: harvesting conditions were very wet and many crops were lifted later than usual, conditions which would encourage infection. Development of the disease in cv. Kerr's Pink was studied by Allen (*Ann. appl. Biol.* 1957, **45**, 293-8), who showed that tuber infection does not occur much before lifting time. Boyd (ibid. 1957, **45**, 284-92) reported on the relation of the disease to tuber cultivar, methods of storage, time of lifting etc., and confirmed the value of organomercury dips in these experiments and (*Eur. Potato J.* 1960, **3**, 137-54) in commercial practice. Some effects of the disease in Scotland were discussed by Boyd and Lennard (ibid. 1961, **4**, 361-77): they showed that, besides lenticel and eye infection, surface abrasions may allow the fungus to penetrate the skin. Hirst and Salt (*Trans. Br. mycol. Soc.* 1959, **42**, 59-66) isolated *O. pustulans* from brown lesions in the cortex of potato root systems and demonstrated the pathogenicity of the fungus from tubers, to root systems of potato and tomato. Amounts of the brown cortical rot of underground parts of plants, caused by the fungus, were considerable in some cultivars in maincrop trials surveyed in 1955-7 inclusive (Salt, *Pl. Path.* 1964, **13**, 155-8).

In winter 1956-57, **Dry Rot** (*Fusarium caeruleum* (Lib.) Sacc.) showed an increase over the previous season in the east Midlands and often followed infection by *Phoma*, but elsewhere was not much in evidence, although in the south, quite a number of seed consignments were substantially infected. Incidence was about average, or fairly low, throughout the country in tubers from the 1957 crop, while in the 1958 crop, it was less than average in almost all areas. Cultivar Craigs Royal was heavily attacked in Holland (Lincs). In tubers harvested in 1959 it was much more prominent, particularly in seed, in which higher amounts than usual were reported from most parts of the country. Many crops sprouted unsatisfactorily, many were failures. In Yorks and Lancs, trouble was noted especially after planting in cvs. Arran Pilot and Ulster Prince. Some counties in the Eastern Region, however, had little in Scottish seed and there was said to be surprisingly little in ware in the Region though, even so, a little more than in previous recent years.

Dry rot was not exceptional in the harvested, 1960 crop, though again there was plenty in the east Midlands, often following blight. In Essex it was fairly serious in much of the seed, and throughout Wales above average in imported seed, in the 1960/61 winter.

Brook and Chesters (*Ann. appl. Biol.* 1957, **45**, 623-34) examined the effect of two tetrachloronitrobenzene isomers, one of them tecnazene, on potatoes. Both controlled dry rot well on five cultivars but failed to give a commercial control with Doon Star. These workers (*Ann. appl. Biol.* 1957, **45**, 498-505) studied the linear growth of *F. caeruleum* and *Phoma exigua* f. *foveata* in culture in the presence of vapour from three isomers of tetrachloronitrobenzene and found each of the latter to be fungistatic but not fungicidal. Boyd (*Eur. Potato J.* 1960, **3**, 137-54) described a method of washing tubers in an organomercury solution in commercial use in Scotland: observations showed that the method could substantially reduce dry rot, skin spot and gangrene.

There was more **Gangrene** (*Phoma exigua* Desm. f. *foveata* (Foister) Malcolmson & Gray) than usual in eastern areas in the early months of 1957. In the 1957/8 winter it was rather above normal in seed, particularly of cv. Majestic, reaching the Eastern Region; and was troublesome in the east Midlands in 1958. Not a lot was reported in the 1958/9 winter. Early in 1960, gangrene was seen in cv. Arran Pilot seed grown in Salop, and this appeared to be the first record of the disease on home-grown seed in the west Midlands. *Phoma* was prominent in spring 1960 in the Northern Region and lead to gappiness, but in the Eastern Region it was less severe than usual. In the 1960/1 winter it was prevalent in some seed stocks. Skin necrosis, also caused by *Phoma* was noted in odd instances only. Malcolmson (*Ann. appl. Biol.* 1958, **46**, 639-50) studied the conditions favouring infection of tubers, and the mode of infection, and demonstrated the differing susceptibility of various potato cultivars. She also (*Trans. Br. mycol. Soc.* 1958, **41**, 413-8) gave evidence that *P. solanicola* Prill. & Delacr., *P. tuberosa* Melhus, Rosenbaum and Schultz and *P. foveata* Foister should be regarded as one species—*P. solanicola*. Boerema (*Persoonia*, 1967, **5**, 15-28) has since given reasons for reverting to the oldest valid name for the organism—*P. exigua*, the gangrene organism being a variety of this. Other work on gangrene is referred to under dry rot (p. above).

Past records for this country show that years when **Pink Rot** (*Phytophthora erythroseptica* Pethybr.) has been particularly in evidence have been little- or no-blight years (e.g. 1933, 1940, 1943, 1951 and 1955). While wet conditions may favour infection, hot seasons, like 1959, are also favourable for field attacks. Pink rot was notably prominent in 1959. Many attacks were encountered in northern counties: cvs. Dr. Mackintosh and Ulster Torch received particular mention. Reports in July from the East Midland Region came especially from the heavier soils of the east coast area. By September, infection was widespread, though patchy, throughout this Region on heavy soil, with up to 50 per cent of tuber infection at lifting time, but more usually about 3-5 per cent. In an outbreak in Lincs, cv. Home Guard was substantially infected on heavy marshland in fields where, on average, potatoes are not grown more than once every seven or eight years. Pink rot was fairly widespread through the Eastern Region and many crops were severely affected: often the affected fields were well-drained. King Edward appeared to be the cultivar most affected, but Majestic, Arran Pilot and Ulster Prince were also attacked. In Hunts it was said to be common in King Edward on peaty loams, but there was little on light peats and mineral soils. Outbreaks were reported from many other parts of the country.

The other dry year of the five, 1961, brought general infection to the East Midland and Eastern Regions. Although virtually absent in all earlies in the former Region, it was very general in maincrops there, though infection levels were only 1-3 per cent: soil temperatures were low early in the season and rose only in the latter part. The disease was troublesome late in the year in I. of Ely, particularly in low-lying fields with heavy soils, where about 20 per cent of the crop was affected. In the rest of the country, scattered outbreaks only were reported in 1961 and the position was more or less the same in 1957, 1958 and 1960. In March 1961, *Phytophthora megasperma* Dreschsl., reported by Cairns and Muskett to cause pink rot in Northern Ireland indistinguishable from that caused by *P. erythroseptica* (*Nature, Lond.* 1933, **131**, 277), was found in a batch of rotting tubers in Glam: the tubers were sent for examination because of complaints about hardness and sweetness on cooking.

Boyd (*Pl. Path.* 1960, **9**, 99-101) found that large tubers were the most frequently infected with pink rot whereas blight was highest in chats. An account of the occurrence of haustoria of *P. erythroseptica* in pink-rotted tubers was given by McKay, Loughnane and Kavanagh (*Trans. Br. mycol. Soc.* 1957, **40**, 407-8), and of the germination of the oospores following passage through the digestive tract of the garden snail by Gregg (*Nature, Lond.* 1957, **180**, 150).

Apart from in the wet 1958 season, **Watery Wound Rot** (*Pythium ultimum* Trow) appeared to be of little consequence. In 1958 about a dozen, moderate to severe, attacks were noted in Salop, and other outbreaks, some of them severe, occurred in the Eastern Region, the Wye Sub-Region and elsewhere. The disease was noticeable in the west Midlands in 1959 and affected several crops in the Wye Sub-Region. More trouble was experienced in the west Midlands in 1961.

More crops were affected with **Stem Canker** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) than usual in the West Midland Region and S. Wales in 1957. This disease was prominent in the east Midlands, Hunts and N. Wales in 1958, but although bad attacks were seen in several places it was not unusually conspicuous in the country as a whole. Several outbreaks in early-planted cv. Arran Pilot in Cornwall in 1959 were serious: half of the seed in one crop produced no above-ground growth and *Rhizoctonia* was abundant on the withered shoots. According to growers the seed had usually sprouted well and no black scurf had been seen; but soil temperatures in the early stages had been low. Attacks were frequent that year in Yorks and Lancs, the East Midland and Eastern Regions and, on earlies, in Hants. Precocious rooting on cvs. Home Guard and Craigs Royal seed in the ensuing winter, followed by a heavy attack of *Rhizoctonia* on the roots and shoots, caused widespread alarm in the early-potato areas of Pemb and Cards.

In 1960, stem canker was particularly widespread, and in many areas severe, sometimes with serious consequences as in parts of Wales. The use of heavily infected once-grown seed resulted in many virtually complete crop failures in S. Wales with others often giving yields of only 1-2½ tons per acre, the upper figure representing about half-normal early production. However, when even quite badly diseased seed was planted into warm sheltered fields, growth was faster and yields much closer to normal. Little potato, and premature tuber formation, were associated with killing of primary

shoots by *Rhizoctonia* in some areas. The perfect stage of the fungus was very common in the east Midlands. In a chitting house in Lincs, heated by four fan heaters placed high up, a definite pattern developed; a layer of cold humid air was produced near the middle of the house owing to incorrect siting of the heaters, and the sprouts on tubers in this zone were killed by the fungus, while other tubers sprouted normally. At the edge of the zone there was a clear dividing line between affected and unaffected tubers in the same box. *Rhizoctonia* was severe in part of a crop of cv. Ulster Supreme in Cornwall: the affected area had been sprayed with chlorpropham weedkiller before the potatoes emerged. The disease was very common again in 1961 in many areas, and caused gapping in some early plantings, but although some heavy attacks were reported it was not as severe as in 1960.

Black scurf on seed was referred to from time to time during the five years but there were few reports of unusual amounts other than those referred to above. Graham, Srivastava and Foister (*Pl. Path.* 1957, **6**, 149-52) investigated the control of tuber-borne *R. solani* with mainly organomercury compounds, and Graham reported that certain ethylmercury chloride compounds were the most suitable of the disinfectants he tested in further experiments (*Eur. Potato J.* 1960, **3**, 80-9). A synergistic relationship between *R. solani* and *Fusarium solani* in the rotting of potato tubers was studied by Elarosi (*Ann. Bot., Lond.* N.S. 1957, **21**, 555-67; 569-85 and ibid. 1958, **22**, 399-416).

Common Scab (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) was severe in few crops in 1957 and was generally at a very low level in 1958 (Fig. 2); but most Regions in 1959 had high or above average incidence (Fig. 3). In the latter year it was widespread throughout the country and some of the most badly affected crops were unsaleable as ware: in their survey in 1952 and 1953 Large and Honey (*Pl. Path.* 1955, **4**, 1-8) had found that in hot dry summers levels of scab were likely to be high. In 1960, scab was seen on a few consignments of seed but was on the whole slight though variable, a few places in the extreme north, the east, south-east and N. Wales having some severe attacks. In 1961, it was general and often severe in crops on light sandy soils in Yorks N.R. and severe in some early-planted crops in the east Midlands. In the Eastern Region scab was unusually common, though often not serious, especially on light silts and on sandy soils. Elsewhere, attacks were mainly slight in 1961.

Annual surveys, just before lifting, were made by Plant Pathology Laboratory, Harpenden and the Potato Marketing Board. Assessments for the period, and Figures 2 and 3, were made by E. C. Large. During the 1950's about 2,050 crops, on average, were looked at each year. The percentage of tubers with $\frac{1}{4}$ or more of their surface scabbed in the total maincrop yield for England and Wales (A) and the percentage of crops 'substantially affected' i.e., having 3 or more per cent by weight of such tubers (B) were:

	1957	1958	1959	1960	1961
A	1	trace	5	2	2
B	8	4	24	13	14

In general, scab was most severe in the north Midlands and the north. The percentage (B) for 1959 was the highest obtained during 1952-61.

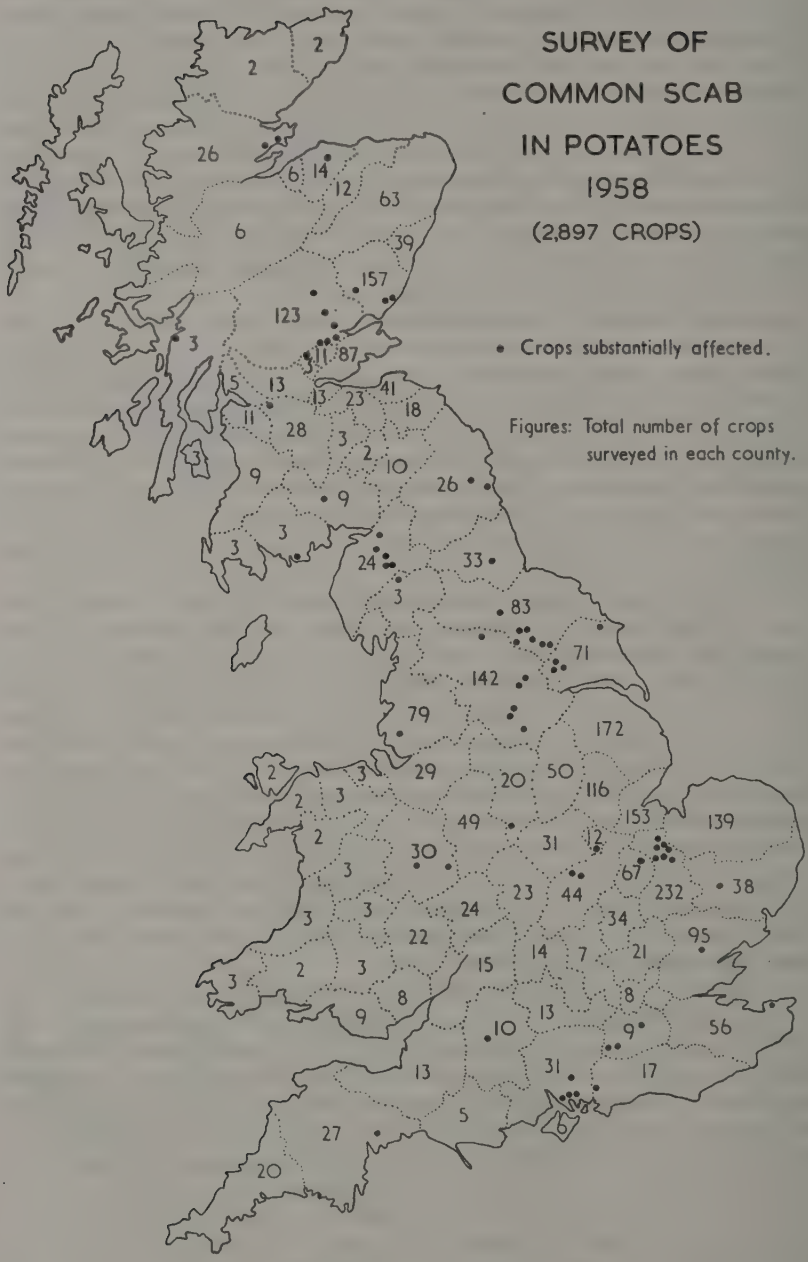

Fig. 2. Location of all potato crops substantially infected with common scab surveyed in each county in England, Wales and Scotland, 1958.

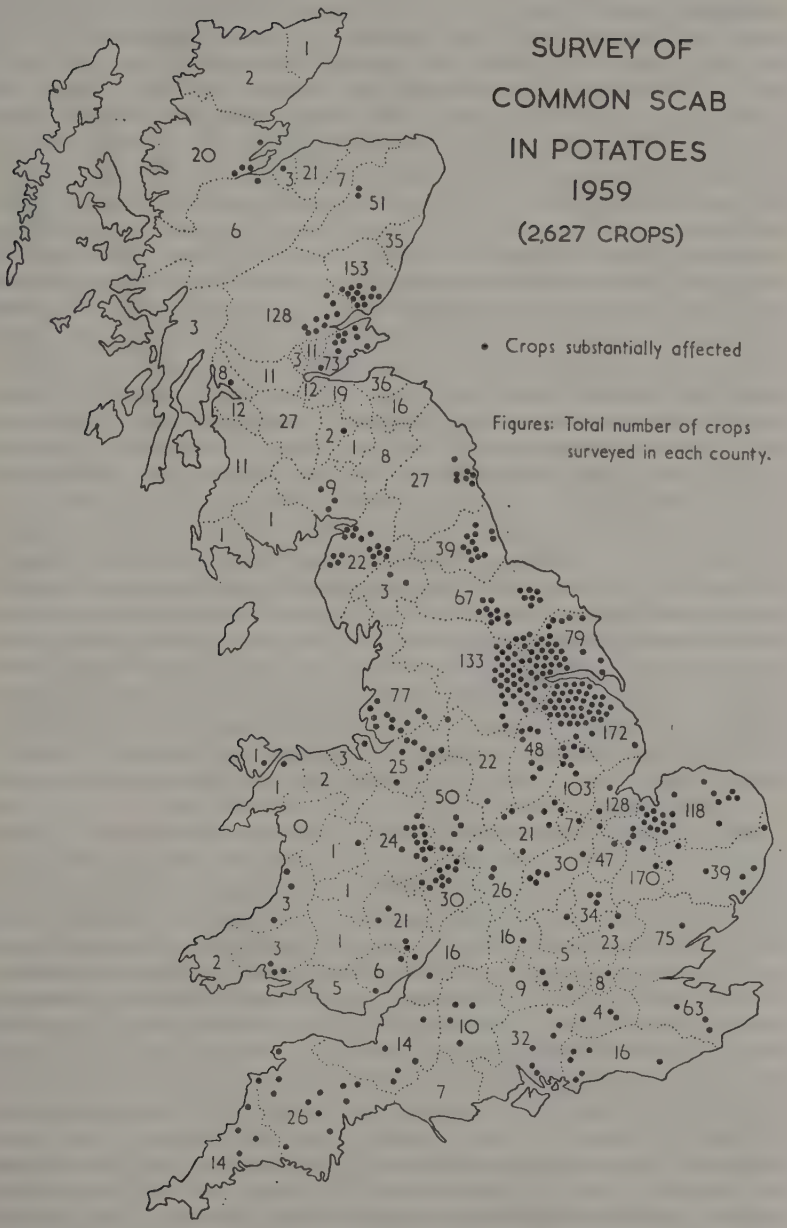

Fig. 3. Location of all potato crops substantially infected with common scab surveyed in each county in England, Wales and Scotland, 1959.

Rosser (*Pl. Path.* 1960, **9**, 61-2) obtained significant control with quintozene applied to the open drill before planting in 1958, when scab incidence was low; but obtained no significant control in 1959, when the scab level was high. After growth in naturally scab-infested soils, tubers of cultivars with varying resistance to scab were examined by Lewis and Nicholson (*Rep. Sch. Agric. Nottingham, 1959*, 53-6) for variations in the surface microflora. McKee (*Eur. Potato J.* 1958, **1**, 65-80) described satisfactory methods for assessing the resistance of cultivars to scab: while isolates of *S. scabies* varied greatly in virulence he found no evidence of physiological specialization.

Powdery Scab (*Spongospora subterranea* (Wallr.) Lagerh. f. *subterranea*) was noted particularly in northern counties and in the west. In 1958, some attacks in the Northern Region were severe (e.g. on cvs. Duke of York, Arran Pilot, Redskin) and in Yorks and Lancs it was exceptionally frequent, especially the canker form. That year saw quite a lot of the scab in the west Midlands, with occasional reports of canker on Arran Pilot, and in mid-Wales. Many reports were received from gardens in the south-west. In 1959 powdery scab was probably above average in consignments of Scottish seed potatoes. The Yorks and Lancs Region had some further attacks in 1961, a year when it was above average in earlies in mid-Wales. Very few farm outbreaks of **Wart Disease** (*Synchytrium endobioticum* (Schilb.) Perc.) are recorded in any year (only five during the whole period) but in a wet year, such as 1958, the number of new outbreaks in private gardens or allotments can rise steeply over the annual average. A dozen or so outbreaks were confirmed each year, other than in 1958 when about 60 were confirmed. The great majority occurred in the north and the Midlands, and none in the Eastern Region other than in the odd garden in Herts. The Wart Disease of Potatoes Order, revised in 1958, continued to prohibit the planting of susceptible potato cultivars on land known to be infected. There was no evidence of the existence in England and Wales of any race of *S. endobioticum* other than the common European race.

The ubiquitous **Silver Scurf** (*Helminthosporium solani* Dur. & Mont.) merely caused enquiry in one area about the suitability of heavily infected cv. Majestic tubers for pre-packaging. **Rubbery Rot** (*Oospora lactis* (Fres.) Sacc.) was newly recorded in the Yorks and Lancs Region in the 1957 crop: it was the sole report of this disease, which was first reported in 1948/9 (Moore, *Br. Parasitic Fungi*, p. 224). **Verticillium Wilt,** usually attributed to *Verticillium alboatrum* Reinke & Berth. and not normally very damaging was reported each year except 1958. Slight local attacks developed in Beds in 1959, and that season brought above average infection in I. of Ely where the disease was mainly in patches. *Verticillium* appeared to be widely present on early-potato sprouts in Pemb and Cards, especially on once-grown seed, at the end of 1959. The wilt was more common than usual in the Eastern Region in 1961 too, and specimens of infected haulm were received from most counties. 1959 and 1961 were the driest of the five years under review. In Kent, *V. dahliae* Kleb. was associated with early death of 5 per cent of the plants in 5 acres of Majestic in 1957. The more or less harmless condition **Black Dot** (*Colletotrichum coccodes* (Wallr.) Hughes) was noticed in several crops in Glam in 1958, being severe in one crop of Majestic, but was no doubt commonly present in the country in crops at the end of each season.

The hot dry season of 1959 when one might have expected black dot to show itself, brought no reports.

White Root Rot (*Rosellinia necatrix* (Hartig) Prill.) was reported from the Scilly Isles on a few occasions in 1958 and 1959. Potatoes had frequently been attacked by this fungus in the Scillies in recent wet summers. There were no other reports. **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was noticed in one or two crops in most years. In 1960 a bad attack in Cambs affected $\frac{1}{3}$ of the tubers in 2 acres of cv. Record, and a few of the other reports spoke of appreciable areas in the crop affected. Apart from the several outbreaks in the Eastern Region, records came from the east Midlands and Som. No outbreaks of **Stalk Break** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were reported, but in June 1960 in Cornwall, several plants of cv. Ulster Supreme showed stem rot at soil level with tiny sclerotia on the stem. The fungus was thought to be *Sclerotinia minor* Jagger.

Of somewhat academic interest, **Powdery Mildew** (*Oidium* sp.) is sometimes seen on potatoes in this country. First recorded here in 1932, it was seen again in 1945, and since then hot seasons have produced the occasional record and it was not surprising to hear of its occurrence in 1959. It was extensive in September in a Majestic crop in a potato cultivar trial at Rochester, Kent, no other cultivar being affected. In that September too, Dr. F. T. Last reported the disease on potted plants of cv. Arran Viking in a glasshouse at Rothamsted. Moore (*Br. Parasitic Fungi*, p. 55) described **Early Blight** (*Alternaria solani* Sorauer) as widely distributed in Britain, sporadic and causing little damage. Though noticed in 1960, the disease drew no comment from plant pathologists and its economic importance appears to be nil.

Brown Rot (*Pseudomonas solanacearum* (Smith) Smith) has never been reliably recorded in the field in this country, but has been intercepted on a number of occasions in consignments of tubers from the Middle East. Plant health inspectors at the ports, who keep a special watch for it, found appreciable amounts of brown rot in a ware consignment from Egypt landed early in 1959. The disease was detected in imported tubers once in 1960, and again in 1961 in a few further ware consignments from Egypt and in one from Cyprus. In each instance appropriate action was taken. Lelliott has recorded the results of inspections for brown rot of potatoes imported into England from 1960-63 (*Phytopath. Mediterranea*, 1964, **3**, 123-4). A potentially, more serious disease which inspectors are on the look out for in imported consignments is **Ring Rot** (*Corynebacterium sepedonicum* (Spieckermann & Kotthoff) Skaptason & Burkh.). This disease has never been recorded in the field in Britain but in May 1958 it was detected in four shipments of Polish ware potatoes at Purfleet, Essex and in two shipments at Goole, Yorks. These consignments were refused entry. Protection against ring rot and brown rot is afforded by current import regulations for potatoes, which include the prohibition of the import of all seed potatoes into England and Wales except under licence.

Most of the main potato areas of England and Wales experienced exceptional amounts of **Black Leg** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *atroseptica* (van Hall) Dye) in 1961 but in most southern counties it was important only in a few crops. By June, in the Eastern Region, the current year's tubers were occasionally affected via the stolons. The Midlands and

parts of the east in 1959, but only the odd Region in 1957 and 1958, had more than usual, while reports indicated little trouble in 1960 except in some eastern counties.

The following table gives details of black leg found at the single (about mid-July) inspection in crops entered for the 'H' certification scheme in the East Midland and Eastern Regions in 1960 and 1961. Most of the crops were grown from Scottish 'A' seed.

	1960		1961	
	Majestic	King Edward	Majestic	King Edward
No. of crops inspected	139	95	133	88
Acreage inspected	1863	1556	1749	1425
Crops affected, per cent	79	64	91	77
Mean black leg/acre, per cent	0·23	0·18	0·46	0·28

Isolates of *Erwinia* associated with black leg were studied by Malcolmson (*Trans. Br. mycol. Soc.* 1959, **42**, 261-9) and Graham and Dowson (*Ann. appl. Biol.* 1960, **48**, 51-7; 58-64). Graham and Volcani found that treatment of whole tubers with mercurial compounds, streptomycin or mixtures of the two did not control black leg (*Eur. Potato J.* 1961, **4**, 129-37).

Soft Rot (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye and other bacteria) was widespread in the east Midlands after heavy rain in late September and early November 1957. Many fields in several counties were partially flooded for up to 48 hours and whole crops were lost. In one field, losses in King Edward were considerable yet Majestic was unaffected. Losses were severe in a number of clamps in Berks in January 1958. Little mention was made of wet rots in the 1958 and 1959 crops except for the I. of Ely, where clamps had quite a lot at the beginning of 1959 and losses were sometimes high. In 1960 the position was different: wet rots were above normal in the east Midlands, and were common in clamps and stores in several counties of the Eastern Region with some considerable loss. In eastern counties, wet rot was very prevalent in crops still in the ground late in 1960 and early in 1961. In some clamps in I. of Ely overheating, following wet rot, caused premature sprout growth. Other areas reported losses. Reasons contributing to the high incidence in 1960 were given as harvesting or clamping in very wet conditions, the amount of blighted tubers in clamps, mechanical damage, bad ventilation and in some cases partial waterlogging of clamps. In 1961, wet rots were again fairly widespread and often severe in the east Midlands and were associated with growth cracks, injury by sprayers' wheels, and other mechanical damage: in I. of Ely rotting followed mechanical damage in much larger amounts than usual. The occurrence of soft rot bacteria in Scottish soils was examined by Graham (*Nature, Lond.* 1958, **181**, 61) and the factors affecting the pathogenicity of bacteria to tubers by Murant and Wood (*Ann. appl. Biol.* 1957, **45**, 635-49; 650-63). A disease of potatoes caused by *Bacillus subtilis* Cohn emend. Pratzmowski was observed in Scotland (Malcolmson, *Rep. Scott. Pl. Breed. Stn, 1960*, 24-8).

Leaf Roll (potato leaf roll virus) was prominent over much of the five years: in every year several Regions, at least, indicated that it was more

common than usual particularly the extreme north, the Midlands and the east, but physiological top rolling (see p. 39) was a complicating factor and rolling associated with stem canker was also not uncommon. In one area of Yorkshire in 1961 a top roll was attributed to massive feeding of the potato aphid *Macrosiphum euphorbiae*.

In 1957, aphid activity was very high in May and June, and primary leaf roll was noticeable in many parts of the country in June. In Kent, about 75 per cent of a 12-acre crop of Majestic showed primary symptoms in July: in this county leaf roll seemed more prevalent than in any year since the early 1940's. Attacks were heavy in some crops in the north and Yorks W.R. in 1958, and incidence was high in the west Midlands and in once-grown crops in the eastern half of the country. Aphid populations again built up early in 1959 and leaf roll became plentiful in most districts: more primary infection was seen in the Wye Sub-Region than for many years and some Kentish crops showed up to 90 per cent of infected plants.

1960 brought exceptionally severe attacks in Yorks and Lancs, with 10-99 per cent in once-grown Majestic crops. In the east Midlands too, leaf roll was severe in most crops from home-saved seed: in view of the healthy crops from certified seed in 1959 the increase was surprising. By July many fields of once-grown Majestic in the Region showed 95-100 per cent with rolled leaves: spread in King Edward was apparent by the end of July. The southern area around the Wash was particularly badly affected and yields were badly reduced. The disease spread into the healthiest new stocks and eventually affected whole fields. With the badly infected stocks and heavy aphid infestation, leaf roll virus appeared to be responsible; moreover a number of crops in the Region which were sprayed with insecticide in June and July were fairly clear. However, leaf rolling, thought not to be parasitic in origin though indistinguishable from virus primary leaf roll, was a feature of the season in the west Midlands and the Eastern Region. Once-grown Majestic seed, collected in 1960 in the east Midlands and grown on in 1961 at Sutton Bonington showed up to 50 per cent secondary leaf roll, indicating heavy spread in 1960. The picture was again complicated in the Midlands in 1961 where rolling of the leaves, apparently partly due to virus and partly physiological, was again widespread. In the east Midlands the low virus content of imported stocks contrasted with once-grown seed from which up to 98 per cent of the plants were infected: many of these poor stocks came from S. Lindsey where widespread primary symptoms were noted in July 1960. Warning against the use of once-grown seed in 1961 had been given and a small acreage only was grown fortunately. **Net Necrosis,** a tuber symptom of primary leaf roll, was rarely reported.

Over the years the regular planting of certified seed had greatly reduced the virus content of potato stocks, but factors such as the high cost of seed led to continued interest in the use of insecticides in ware-growing areas to control the aphid-transmitted leaf roll and Y viruses, and growers in some areas were being encouraged to retain their stocks for longer periods by use of sprays and by roguing (Broadbent, *Outlook on Agriculture*, 1958, **2**, 13-15; Brown and Broadbent, *Agriculture, Lond.* 1960, **66**, 506-8). The economic aspects were considered by Broadbent, Burt and Nix (*N.A.A.S. q. Rev.* 1957, No. 38, 144-52). Broadbent with various colleagues showed that stocks could often be retained for several years by application of contact or systemic

insecticides (*Pl. Path.* 1958, **7**, 53-5; *Eur. Potato J.* 1960, **3**, 251-62; *Ann. appl. Biol.* 1960, **48**, 580-90; *Expl Hort.* 1961, No. 4, 8-12, No. 5, 37-9; *Proc. Insecticide and Fungicide Conf. Brighton, 1961*, **1**, 81-5). Tuber treatment with systemic insecticide was also being investigated (Newman, ibid. **2**, 441-50).

Broadbent *et al.* (*Ann. appl. Biol.* 1957, **45**, 603-22) and Cadman and Chambers (ibid. 1960, **48**, 729-38) investigated the effect of date of planting and other factors on virus infection. Experiments (Cadman and Chambers, *Ann. appl. Biol.* 1960, **48**, 729-38; Heathcote and Broadbent, *Eur. Potato J.* 1961, **4**, 138-43) confirmed that most spread of leaf roll and Y within the crop occurs early. Aspects of aphid transmission of leaf roll and other viruses were studied (Harrison, *Virology*, 1958, **6**, 265-77; 278-86). Incidence and control of aphid-borne virus diseases in Scotland were discussed by Todd (*Eur. Potato J.* 1961, **4**, 316-29). Virus aspects of seed potato production in Northern Ireland (Proudfoot and McCallum, ibid. 330-40) and in Cumb (Rogerson and Barker, *N.A.A.S. q. Rev.* 1961, No. 52, 177-84) were reviewed. A staining technique for detecting leaf roll in tubers had limited use in England (Broadbent and Heathcote, *Pl. Path.* 1960, **9**, 126-8).

Rugose Mosaic (mostly potato virus Y) was frequent in crops of once-grown seed in the west Midlands in 1957 and formed part of the pattern of above average incidence of potato virus diseases in other areas. Leaf drop streak symptoms of virus Y were very marked in the East Midland Region that year, after aphid activity had been very high in May and June. In 1958, severe mosaic was widespread in the west Midlands by July and was more prevalent than usual in the Eastern Region with some serious attacks on cv. Ulster Torch. Virus diseases generally were above normal in the south-east and in Wales. Leaf drop streak was in evidence in the east Midlands, and widespread in Berks, in 1959: severe mosaic remained high in crops twice-grown, or more, from new seed in the west Midlands. Rugose mosaic was particularly widespread in 1960 in most Regions, though very little was seen throughout the east Midlands: leaf drop streak was noticeable in some areas. Some attacks were very heavy, for example in Kent a 30-acre crop of cv. Arran Comet was 95 per cent affected in May: the seed was once-grown and was reputed to have been sprayed several times during the growing season. Several potato crops had 30-50 per cent of plants with severe mosaic in Berks and Hants, and one of Majestic in Oxon had 99 per cent. Both once-grown and Scottish seed were affected in the south-east. In 1961, cv. Ulster Glen showed severe mosaic in the Yorks and Lancs Region while, in the Midlands spread of Y was rather greater than usual and leaf drop streak prominent. Virus diseases generally were widespread in home-saved seed in the east, but in the south-east they spread less than in 1960. The incidence and spread of virus Y in the crop and the reaction of cultivars to infection with it was under study in Northern Ireland (*Res. exp. Rec. Minist. Agric. Nth. Ire. 1957-60*, **8-10** incl.). Watson presented evidence (*Virology*, 1960, **10**, 211-32) for interaction or genetic recombination between viruses Y and C in infected plants.

Tobacco Veinal Necrosis (a strain of virus Y) (Plate XII, 1) had been noted in England in cv. Craigs Royal. Richardson (*Pl. Path.* 1958, **7**, 133-5) concluded that it was unlikely that it could become epidemic in areas where strains of Y are common. Its control in Scotland, since its discovery there in commercial stocks of Craigs Royal in 1953, was discussed by Todd (*Proc.*

4th Conf. on Potato Virus Diseases, Braunschweig, 12-17 Sept. 1960, 82-92).

Mild Mosaic (mostly potato viruses X and /or A) was prevalent in many stocks throughout the country but has no serious effect on yield. Work was done on the preparation of antisera to X (Govier, *Rep. Scott. Pl. Breed. Stn, 1958*, 77-81) and the effect of refrigeration on X, Y and the veinal necrosis strain of Y (*Res. exp. Rec. Minist. Agric. Nth. Ire. 1957-60*, **8-10** incl.). Virus A was found to be the main cause of mosaic in cv. Ulster Torch in Northern Ireland (Calvert, *Pl. Path.* 1960, **9**, 144-6). **Aucuba Mosaic** (potato aucuba mosaic virus) was noted affecting isolated plants in many crops in N. Wales in 1961. Potato virus **S** was known to be a common cause of mild symptoms: its occurrence in Northern Ireland seed stocks was surveyed (*Res. exp. Rec. Minist. Agric. Nth. Ire. 1957*, **7**, 214-5; *1959*, **9**, 209).

Most King Edward plants from the seven commercial stocks tested contained **Paracrinkle** virus and virus S, some contained only paracrinkle and a few only S (Kassanis, *Eur. Potato J.* 1961, **4**, 14-25; *Nature, Lond.* 1960, **188**, 688). Kassanis and Schwabe (*Ann. appl. Biol.* 1961, **49**, 616-20) studied the effect of paracrinkle virus on the growth of King Edward at different temperatures and daylengths. Howard and Wainwright concluded that paracrinkle symptoms in cv. Arran Victory are produced by the virus **M** component alone of the virus complex found in King Edward (*Nature, Lond.* 1960, **186**, 993-4): Kassanis (ibid. **188**, 688) commented on the relationship between paracrinkle and M viruses. Plants freed from paracrinkle and S viruses were produced by tissue culture (Kassanis, *Ann. appl. Biol.* 1957, **45**, 422-7), and paracrinkle-free King Edward became available later for commercial use.

Several reports of **Spraing** (tobacco rattle virus) were received annually. In 1958 it was widespread in cv. Ulster Torch on light sandy soils in one area of the west Midlands. In a single field in Notts, 90 per cent or more of the Ulster Torch but none of the Majestic plants was affected. In 1959, Ulster Torch was the only cultivar reported to be affected in the east Midlands. Symptoms on leaves of cv. Red Craigs Royal are illustrated in Plate I, 2. **Stem-mottle** and spraing were thought to have closely related causes (Cadman, *Eur. Potato J.* 1959, **2**, 165-75) and there was evidence of their association with tobacco rattle virus. Harrison (*Ann. appl. Biol.* 1957, **45**, 462-72) recorded the previously undescribed **Beet Ring Spot** virus in potatoes. His work indicated (*J. gen. Microbiol.*1958, **18**, 450-60) that this virus and potato bouquet virus (from Germany) are strains of tomato black ring virus. He also studied the pattern of field infection and pointed out the danger of the virus, which can decrease yields without causing obvious symptoms (*Ann. appl. Biol.*1959, **47**, 557-64). Records of beet ring spot virus on potatoes in England in 1957 and 1958 were given in the annual reports of N.I.A.B. for those years (pp. 24 and 27 respectively). In 1961 a plant of cv. Craigs Alliance (Scots seed) in Kent had very many thin sprouts and many $\frac{1}{2}$- to 1-in. tubers: symptoms suggested the presence of potato **Witches' Broom** virus. A plant with similar symptoms was seen at Sutton Bonington in the same year. Macarthur (*Rep. Scott. Pl. Breed. Stn, 1958*, 75-6) refers to the records of **Cucumber Mosaic** virus in potatoes from England and Scotland.

It is not always possible to associate **Leaf Rolling** with any pathogen and sometimes a physiological cause seems the only explanation. In 1958 this

trouble was locally affecting complete crops in the Yorks and Lancs Region, usually following waterlogging. In contrast it was frequent on dry soils in this Region in 1960. Not all the frequent leaf rolling in the west Midlands in 1960 could be attributed to virus or stem canker; and top rolling, thought not to be parasitic in origin, became increasingly prevalent in Majestic and Craigs Alliance crops by the end of July 1961 in the Region, being less severe in King Edward. There were many complaints from the South-eastern Region in July 1959 and up to 70 per cent of some Majestic crops were affected: its widespread occurrence and field distribution, the lack of secondary leaf roll in crops and an association with early planting on a cloddy tilth suggested a physiological effect associated with drought. Many affected crops recovered well following early August rain. Apparently healthy plants were grown under glass during the winter from tubers collected from plants affected in the field. In 1960 top rolling was again common, and restricted to Majestic, in the South-Eastern Region, and common also in this cultivar in the Eastern Region.

Second Growth and associated phenomena **Chain Tuberisation**, waisted tubers, severe growth cracks and **Jelly End Rot** are particularly noticeable in certain seasons and areas. The outstanding season was 1957 when second growth and jelly end rot, particularly, were reported from many parts of the country and were especially prevalent in the south-east, Wales and the north. In the East Midland Region it was one of the worst years experienced for this kind of damage. Glassiness, too, affected crops in some areas. Jelly end rot, chain tuberisation and abnormal sprouting effects again afflicted many crops in the east Midlands in 1959, a year when second growth was prominent in the Midlands. Second growth was again very general in the east Midlands in 1961, often with glassiness and jelly end rot. Glassiness totally affected a 12-ton consignment of Majestic in Kent in 1958. **Tuber Cracking,** also often associated with second growth and mentioned above, appeared to be prevalent in 1961 in Devon and Cornwall, and was noted in the same year in a few crops in the south-east and mid-Wales. It accompanied second growth and common scab in some very serious outbreaks in I. of Ely in 1961 in cv. Majestic. **Rubberiness** or **Shrivelling** of tubers was a facet of 1959 in some localities. Rubberiness occasioned numbers of enquiries in the Northern Region and the west Midlands, and the condition was attributed to prolonged growth of the haulm in the very dry soil. Many otherwise healthy tubers lost water and became rubbery in Hunts, Suffolk and I. of Ely where there was more second growth than usual. Bintje and other cultivars produced rubbery and slightly shrivelled tubers in the South-eastern Region, the condition being attributed to drought. Shrivelling was apparent in a fair proportion of some crops on lifting in the east Midlands, especially on the lighter soils, in 1959.

Most **Little Potato** occurred in 1960. Crops in the Yorks and Lancs and East Midland Regions were affected: outbreaks were frequent throughout the latter and, in almost every one, the crops were from once-grown seed, no trouble being seen in Scottish stocks. Seed dug earlier than normal seemed to be the more affected. The excessive sprouting resulted in a great deal of damage at planting. Much coiled sprout, and the hair sprout condition, were present in some crops showing little potato in the east Midlands: the statement in an earlier review in this series (*Bull. Minist. Agric. Fish.* 1944, No.

126, p. 23) that sprouting tubers in light is a sure preventive of the trouble was not borne out in 1960. Gappiness in N.I.A.B. 'bulking trials' with once-grown first-earlies in Thanet proved to be due mainly to this disorder in 1960. Differences in susceptibility of cultivars to little potato were suggested by the percentage of gaps (assessed by the District Officer on 14 May) as given below. The percentages are the average of randomized plots in four blocks (three with Ulster Premier):

Pentland Beauty	1	Arran Pilot	15	Ulster Premier	64
Arran Comet	8	Home Guard	25	Ulster Magnet	68

Seed of these same cultivars from Northern Ireland, received on 13 December 1959, and boxed for chitting on 18 January 1960, gave normal plants without gaps. The 1960 season also saw numerous outbreaks of little potato in Devon and Cornwall, frequently with *Rhizoctonia*. Desprouting—sometimes more than once—followed by planting into cold soil may have been responsible, but another possible factor was the early lifting of the seed in 1959 when soil temperatures were high and tubers perhaps not fully mature. In many instances the seed, home-saved, was lifted in August 1959 and sprouting was very forward. In Pemb, little potato and premature tuber formation were frequently associated with killing of the primary shoots by *Rhizoctonia*, and with desprouted setts and cold soils too. Little potato was reported in a few crops in 1957 and 1958; where the cultivar was mentioned it was more often than not Dr. McIntosh. There were no reports in 1959. In 1961, crops in the east Midlands from late-delivered Scottish seed and from seed clamped and subsequently desprouted by the farmer often showed the condition, and in I. of Ely it was more prevalent than usual by June, particularly in Majestic.

Potato tubers sometimes fail to produce a good stand in the field in the apparent absence of pathogens or other possible cause. The condition is referred to as **Deep Dormancy**. Such a condition was apparent sporadically in May 1957 in several parts of the east Midlands: in each case the buds in at least some of the eyes of each tuber examined were alive and subsequently grew well in the laboratory. In 1958, crops in several Northern and Eastern Region counties failed to sprout and, in 1960, slow sprouting was reported from Dur in May.

During summer 1958, the trade press reported a 'mysterious trouble' affecting Guernsey potato crops, including cvs. Arran Pilot and Home Guard, and at one time 20 farms were said to be involved. Later that year, similar trouble turned up on several Suffolk farms, involving King Edward, Arran Pilot and Majestic. The striking symptoms led to the names **Coiled Sprout** and **Spindly Sprout** because the first shoots, which were markedly swollen, appeared to curl round on themselves several times, and later shoots were extremely spindly. Since then the trouble has become more familiar, though the full explanation of the condition is still not known. Pitt, Hardie, Hall and Graham (*Pl. Path.* 1955, **14**, 19-22) showed that *Verticillium nubilum* Pethybr. can cause coiling; the fungus was commonly associated with the condition in the field, but as coiling also occurred in the absence of fungal lesions, they considered that *V. nubilum* is unlikely to be solely responsible. However, attempts by these authors to relate the condition to the use of

herbicides or to soil compaction failed. In the east Midlands in 1960 some crops showing little potato were appreciably affected, and spindly sprouts were occasionally seen in chitted crops in Norfolk the same year. In 1961, sprouting abnormalities were unusually common in the Eastern Region, especially brittle and/or coiled sprouts: in I. of Ely about 30 per cent of Arran Pilot plants were affected in a 6-acre crop. Occasional specimens with twisted sprouts were received from the east Midlands in 1961. In 1960, **Bud Proliferation** was rather frequent in Majestic in the Yorks and Lancs Region and appeared in several parts of the east Midlands. It was scarcely noted otherwise.

Black Heart was present in all tubers lifted from a crop in Ches in which loss was severe due to flooding during September 1957. The few other reports were mainly from the west Midlands. Symptoms attributed to **Sun Scald** were present in a small percentage of tubers lifted in July as seed for the next season on a Sussex farm in 1959. **Greening** was much more prevalent than usual in the 1961 crop in the west Midlands especially in King Edward. It was attributed to soil panning following wet conditions in the spring forcing tubers to the surface. **Blackening** of the flesh appeared to be worse than usual in the 1959 crop in I. of Ely, giving some trouble before and after cooking early in 1960. The generally wet conditions during the summer and autumn of 1960 were followed by the appearance of **Hollow Heart** in the South-western Region but other records were minimal. **Mechanical Injury** to tubers in the form of cuts etc., was worse than usual in early and late crops harvested in 1961 in I. of Ely: tubers had matured slowly. **Internal Bruise**, characterized by small grey to black areas in the flesh near the surface, was apparently much more common than usual in the winter of 1959/60 and presumably accentuated by the dry summer of 1959: symptoms were very prevalent in ware in the east Midlands and the south and were extensive in some crops, for example where lifted under very dry conditions and by elevator digger. In the Eastern Region, ware potatoes, especially King Edward from the black fen soils were exceptionally susceptible and some consignments became unsaleable a day or two after riddling. In an investigation of one of these cases, by the N.A.A.S. Regional plant pathology department, many tubers were found to be heavily attacked by silver scurf, and there were indications that these tubers were particularly prone to the trouble. Bruising was not a notable feature of the other seasons, though it was prevalent in both home-saved and Scottish seed in the South-western Region in 1959. **Internal Rust Spot** was seen on occasions and in varying amounts. Over 10 tons of Arran Consul was affected in Worcs. This trouble and spraing were present in three cultivars grown on land reclaimed from bracken in Anglesey: this was the first year of ploughing and no manure or fertilizer had been used. Arran Peak was the only cultivar affected but 40 per cent of this showed symptoms. **Pit Rot** was extensive and severe in one or two consignments of seed received in England. Two outbreaks in ware were seen in the east Midlands, the trouble apparently being due to ammonia gas liberated in the clamp. The whole of a $\frac{3}{4}$-acre patch in 12 acres of Majestic developed tubers bearing swellings, best described as **Knobbly Tubers**, in Yorks E.R. in 1958. An interesting condition found at Rosewarne E.H.S. in 1957 in N.I.A.B. seed cv. Jersey Royal was **Sub-epidermal Root Invasion** presumably by grass roots.

Frost Injury affected growing crops in some areas, particularly in June 1957 (Cumb, Yorks and the Midlands) and May 1961 (Notts, South-eastern Region and Wales). Widespread frost damage in June 1961 in the south-west led to several false alarms of blight attack. Frost damaged several stored ware crops in the east Midlands early in 1958, and a few in the Eastern Region and elsewhere. Frosting was considerable in several tuber consignments in Dorset that year. Frosts early in November 1959 badly damaged tubers in the ground, and in clamps not properly covered, in the Eastern Region but instead of the usual black-grey colouring in frosted or chilled tubers, rusty brown predominated. Very few farms in the Region escaped without some frosting of tubers but it was severe only on a few. Serious damage was caused also to some clamps in the east Midlands in November 1959. There were many instances of frost damage at the end of 1961 in N. Wales and in the east Midlands: almost all samples from the latter showed marked lack of vascular discoloration, most discoloration being in the central areas of the tuber.

Unusual internal discolorations were present in a large number of samples of cv. Majestic tubers examined in the plant pathology department, N.A.A.S. Cambridge, between mid-November 1959 and mid-January 1960. This account is based on a report from Miss J. Ives. The symptoms, all or only some of which might be present in a single tuber or in a sample, were as follows.

(a) a rusty to dull brown staining of the vascular tract;

(b) sinuous brown lines and arcs in the cortical tissues below the skins, sometimes running into the vascular tract;

(c) cell breakdown in pockets of tissue in the cortex between the brown lines and the skin;

(d) brown rings in the pith, often enclosing soft, buttery tissues;

(e) collapse of tissues leading to wet rots.

Sometimes the symptoms occurred in tubers also showing normal frost injury, such as grey staining of the vascular system and internal grey spots and streaks. The symptoms resembled the 'Internal Mahogany Browning' described by Hilborn and Bonde (*Am. Potato J.* 1942, **19**, 25-9) only in that the colour was similar, but in the English samples there were no 'blotches' or 'patches' of brown discoloured cells. No organism was found in the brown tissues. Circumstantial evidence suggested however that freezing under special, unusual, circumstances may have caused the disorder. The affected tubers had all been taken from clamp, and all had been lifted before 10 November, and covered lightly, if at all; earthing up taking place after 12 November. Clamped tubers suitably protected by that time, or stored indoors did not have the trouble. Minimum temperatures (°F) 2 in. above grass in mid-November were as follows:

Date	*Wisbech*	*W. Raynham (Norfolk)*	*Cambridge*
5 Nov	22·5	39	37
6 „	16	30	25
7 „	18·5	21	22
8 „	19	23	22
9 „	22	37	37
10 „	13	27	30
11 „	11	20	23
12 „	14	14	18
13 „	33	15	19
14 „	29	36	38

This represents a series of unusually low temperatures for this time of year. It came after a particularly hot dry summer. Such a combination of conditions may have affected the tubers adversely.

Cold Chlorosis, usually attributed to low temperatures during emergence of the shoots, was reported in a few crops in S. Wales and the west Midlands: after yellow blotching of the lower leaves of cv. Ulster Torch had appeared in Salop and Herefs in June 1958, subsequent growth proved symptomless and vigorous. In 1959, Arran Pilot, but not Home Guard, was affected in the early-potato growing areas of Glam. **Cold-Wind Damage** affected Arran Pilot but not Home Guard crops in Pemb in April 1959 and was noted in S. and mid-Wales in 1957 and 1958; leaf silvering and puckering being mentioned as symptoms. Damage by wind was evident on early crops in Pemb in April and May 1961. In 1959, **Chilling** of seed caused failure in a number of crops in mid-Wales, and there were several reports from S. Pemb in May especially with Irish seed. Low temperature injury to seed was noted in other reports.

Lightning Injury, affecting small patches, though in some cases 20-30 ft in diameter, was seen a few times. Usually a single patch was affected but in one crop in Som a well-defined 20 ft diameter patch had a few outlying patches about 5 ft across. In 1960, several crops were hit in the east Midlands. I. G. Thorpe provided a detailed description of symptoms, suspected of being caused by lightning, seen on 1 July 1959 in a King Edward crop near Bristol:

> A roughly circular patch of prostrate plants had developed in the centre of the field, the remainder of the crop being normal and just in flower. Odd single plants within a few yards of the patch were also prostrate. From flower to root the main stem was water-soaked, weak and dead, later becoming shrivelled and black. Water-soaking in some plants occurred only at ground level and at the top of the stem. Usually leaves and petioles were normal with practically complete abscission from the stem but still attached by the lower epidermis. Occasionally leaves showed blight-like symptoms. Still-living parts were not noticeably distorted. Hollows were apparent in the pith, and the pith column was broken into small discs. When symptoms were less severe, the main stems were prostrate, twisted and corkscrewed, petioles were curved and there was abundant side shoot development. Thistles in the centre of the patch were similarly affected.

The only mineral deficiency diseases mentioned in reports were **Potassium Deficiency** and **Magnesium Deficiency**, and the conditions were very rarely severe. Symptoms which came to the attention of pathologists in the early 1960's were associated with the use of the, then recently-introduced, systemic haulm desiccant diquat. Otherwise reports of **Chemical Injury** were few. The main features associated with use of the desiccant were partial or total blackening, or sometimes browning, of the vascular ring of the tuber and a collapse of tissues at the stem end; such symptoms are associated, usually to a milder degree, with other forms of shock too. Tangential sections near the heel end gave the appearance of a fine network. Discoloration may not extend out of the vascular ring itself. Affected crops in 1961 included ones sprayed at twice the recommended rate or while plants were still growing actively or sprayed during a dry period.

Several crops suffered severe setback in Hunts in 1958 due to chits being scorched off: in every instance some type of close fertilizer placement was being attempted. Hormone weedkillers drifted to one or two crops, producing malformations. In Salop, small, circular, brown lesions were present on tubers of cv. Ulster Chieftain which had been washed and treated with a mercurial fungicide. In Scotland, Boyd reported that excessive concentrated sulphuric acid, used for haulm destruction, had produced tuber symptoms simulating pink rot (*Pl. Path.* 1957, **6**, 114).

Diseases of Roots and Fodder Crops

Sugar Beet

The Ministry is greatly indebted to Dr. R. Hull, Director of the Broom's Barn Experimental Station, Higham, Bury St. Edmunds (until 1962 a Field Station of Rothamsted at Dunholme, Lincs), for access to the Station's summarized reports of sugar beet diseases. The reports are compiled each month of the season from information gathered from the British Sugar Corporation fieldmen, and provide an unusually comprehensive account of the diseases of a crop plant. The account of beet diseases in this section of the bulletin has been based very largely on the Dunholme summaries.

In 1960, the second edition of *Sugar Beet Diseases* (*Bull. Minist. Agric. Fish. Fd*, No. 142), written by Dr. Hull, appeared and provided a detailed account of the full range of maladies which afflict the crop. Hull also discussed the health of the sugar beet crop in Britain in *Jl R. agric. Soc.* 1961, **122**, 101-12.

The outstanding disease, virus yellows, is discussed on p. 49.

The effects of fungal **Black Leg** were on the whole slight. *Pleospora björlingii* Byford, the main cause, is largely checked by routine seed treatment and, by 1954, all sugar beet seed distributed from British sugar factories was treated with an organomercurial dust: moreover the British Sugar Corporation decided that, in 1961, all the 8/10 64ths rubbed-and-graded, gravity-separated, seed was to be steeped in ethyl mercury phosphate (Byford, *Br. Sugar Beet Rev.* 1961, **29**, 119-20 and 122) which was considered to be more effective (Byford, *Rep. Rothamsted exp. Stn, 1959*, 193-4; Gates, *Ann. appl. Biol.* 1959, **47**, 502-10) than using dusts.

In 1957, severe black leg occurred mainly in East Anglia and Lincs. The following year, seedlings were affected in all factory areas but though the disease was often widespread, and in some places above average, significance and losses were, with few exceptions, small. Following the wet harvest of 1958, prevalence of black leg was a feature of the 1959 crop but the final stand was not generally affected as growing conditions were good: however, in the Spalding area up to 20 per cent of plants was lost in the worst-affected crops. Following excellent harvest conditions in 1959, the 1960 sowings germinated very well and incidence of black leg was very low. The 1961 sowings with EMP-treated seed established well and reports indicated freedom from black leg. No undue amounts of crown rot or stem rot due to *P. betae* were recorded during any of the five years but the leaf spot was particularly prominent in parts of Norfolk and Suffolk in 1957. The black leg fungus is commonly known in its imperfect state, *Phoma betae* Frank: Cornford (*Pl. Path.* 1958, 7, 113-4) found perithecia of *Pleospora björlingii* Byford (syn. *P. betae*) on dried stems of wild beet from an experimental plot at Dunholme, Lincs in October 1957—the first time the perfect stage had been found in Britain. Perithecia were again found in dried stems of wild and sugar beets at Dunholme in 1958. Booth and Cornford (*Trans. Br. mycol. Soc.* 1959, **42**, 119-20) described the perithecial stage.

Corticium solani (Prill. & Delacr.) Bourd. & Galz., a soil-borne agent of black leg, caused losses of fodder beet during dry seed bed conditions in April and May of 1957, 1958 and 1959 in S. Wales. The fungus was recorded in isolated instances in most areas but, in general, incidence was low. *Rhizoctonia* severely damaged crowns in a crop in Yorks N.R. in July 1959. **Root Rot** (*Aphanomyces* sp.) was noted in Notts in 1961. Waterlogged areas were observed in many crops in the East Midland Region in 1958: a high incidence of *Aphanomyces* was found in the roots but it was uncertain how far the fungus itself was affecting the roots. Some workers refer to the *Aphanomyces* on sugar beet in this country as *A. cochlioides* Drechsl. No information was available on the part played in black leg by *Pythium* spp. during the five years.

Downy Mildew (*Peronospora farinosa* (Fr.) Fr. f. *betae* Byford) was not of major importance and was mainly of concern in root crops near to infected seed crops in East Anglia. It was unusually widespread in 1957 and was very prevalent in May in seed crops in the Spalding area of Lincs and in S. Lincs and Beds. Spread to root crops meant that, by July, all crops in the Spalding area were affected with up to 50 per cent in the seed-growing areas. Except in some eastern areas little fresh infection occurred in August and, apart from the worst affected crops, recovery was good.

Although 1958 brought less mildew generally than 1957, the average incidence was still above that in most recent years. In May it was noticed in eastern districts, and affected seed crops fairly heavily in the Spalding area. Most factory areas reported occasional mildew in June, and incidence remained much the same in July with a few severe attacks only. By September, occasional affected plants or patches had occurred in areas previously free, notably Yorks, the Southern factory area and Pemb. In most areas recovery was apparent with fresh leaf growth. In the Eastern Region mildew became fairly common late in the season.

In 1959, infection was confirmed in April on seed plants in Norfolk, and in May occasional plants were found to be affected mainly in East Anglian factory areas. Many areas had still not reported mildew by June; the others still reported only occasional infected plants, though more severe attacks developed in one or two eastern districts. In general the amount in both root and seed crops in the Eastern Region was thought to be below average.

Incidence throughout the summers of 1960 and 1961 was generally low everywhere, and sometimes less than usual though some infections were heavy near seed crops. By the end of the summer, infected plants could be found in most areas. Special measures had been taken in steckling beds in 1961. It was virtually absent from the majority of crops in the South-eastern Region that year.

Byford and Hull (*Ann. appl. Biol.* 1967, **60**, 281-96) quote the following mean percentage infections of downy mildew in British sugar beet crops in the five years:

1957	1958	1959	1960	1961
1·29	0·61	0·15	0·03	0·09

A detailed account of this disease was given by McKay in *Field studies on the downy mildew of sugar beet* 1957, Dublin: Irish Sugar Co. Ltd. Cornford

(*Pl. Path.* 1958, 7, 38) found oospores of *P. farinosa* for the first time in England, in material from Lincs and Norfolk. Experience with fungicidal sprays had brought mixed success in control of mildew and trials with various compounds were being made at Dunholme Field Station.

Believed not to be a serious danger to the beet crop under normal conditions, **Powdery Mildew** (*Erysiphe betae* (Vañha) Weltzien) had, in general, been more frequent and severe at about this time. It was prevalent in several East Anglian factory areas in 1957 and was noted in the west Midlands and the south. In 1958, mildew was noted in many areas, and in parts of the east Midlands in most fields. As might be expected in the hot dry year of 1959 it became unusually prevalent by autumn, being general in the south and east though more sparse to the north and west. Parts of Lincs had widespread, and sometimes very heavy, infection. In East Anglia generally, incidence was high and in many counties above average: completely affected crops were often found but no damage was evident. In 1960 and 1961 the mildew was again prevalent in many areas: in the latter year the heaviest incidence for many years was reported from the Ipswich factory area.

Rust (*Uromyces betae* Kickx) occurred regularly in most areas. In 1957 some attacks in S. Wales were severe, and in 1959 it was more common than usual in the Eastern Region. In May 1960 most sugar beet crops in the Spalding area showed infection. It occurred in several parts of the country in August 1960 and was widespread in many areas by September. By October, incidence was above average in the west Midlands and I. of Ely, but the disease normally was not serious anywhere that year. Many seed crops were badly affected in I. of Ely early in the 1961 season. Infection was moderately severe in several crops in Cornwall in 1961 and was fairly widespread, but not serious, in some other areas.

The widely distributed **Leaf Spot** (*Ramularia beticola* Fautr. & Lamb.) attracted attention in the wet year of 1960 when it appeared to a greater extent than is usual in the west Midlands, I. of Ely and Holland (Lincs), and had defoliated some crops in Devon and Cornwall by August. This experience in the south-west prompted some cooperative work on control by Dunholme Station and the British Sugar Corporation, from which it appeared that spraying and choice of cultivar offered hopes of keeping the disease in check in the area (Hull, *Rep. Rothamsted exp. Stn, 1961*, 206). Only in the odd crop was severe damage reported during the whole period, other than in Devon and Cornwall in 1960 and in one locality in Cornwall in 1961. **Leaf Spot** (*Cercospora beticola* Sacc.), also of wide distribution, was common in some areas in the south, but was of no apparent importance. Pleospora leaf spot is mentioned on p. 46. Leaves of beet infected with yellowing viruses are very susceptible to infection with *Alternaria* spp. and other fungi (Russell, *Ann. appl. Biol.* 1960, **48**, 721).

One or other of the Eastern Region counties reported **Violet Root Rot** (*Helicobasidium purpureum* Pat.) to be prevalent, or even above average in 1957, 1958 and 1960 but the disease was not widespread or severe: otherwise a few roots only of sugar or fodder beets were affected in the few recorded outbreaks in other parts of the country. **Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) was rarely severe. In 1960, **Fusarium Root Rot** (*Fusarium culmorum* (W. G. Smith) Sacc.) was scattered through crops badly affected by dry conditions in Norfolk. A few severe attacks of **Clamp Rot**

(*Botrytis cinerea* Fr.) developed in fodder beets in S. Wales in 1957, but this fungus and *Pleospora björlingii* apparently caused no great losses in stored beets. Cornford (*Trans. Br. mycol. Soc.* 1960, **43**, 155) found *Paecilomyces betae* (Delacroix) Cornford on dried stems of wild and sugar beets at Dunholme, Lincs in 1958.

The only bacterial disease reported was **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) and that only on the odd plant.

Virus Yellows (beet yellows and beet mild yellowing viruses) is of outstanding economic importance. However, the early 1950's had seen a decrease, year by year, in its incidence until in 1956 the lowest level ever was recorded. Hygienic measures directed at overwintering sources of the viruses, and of the aphids which transmit them, had appeared to be keeping yellows in check, but 1957 saw the most severe outbreak yet experienced: moreover, each of the next four years which are of concern to this review brought further early infestations and a threat by yellows to the sugar beet crop. However, the introduction of regular spraying with systemic insecticides which delayed the onset of yellows and enabled advantage to be taken of the good growing conditions for the crop and also, in 1958, the summer weather unfavourable for aphids, limited the effects of yellows in most areas in 1958-61 inclusive and resulted in some record overall yields and sugar contents. The first of these four years saw the introduction of the Spray Warning Scheme, now co-ordinated annually for all factory areas by Broom's Barn Experimental Station (formerly by Dunholme Field Station); and the use of systemic insecticides, such as demeton-methyl, dimethoate, fluoracetamide and phosphamidon, quickly became standard practice. Newer insecticides, such as phorate, thiodemeton and dimethoate, were being developed as sprays or for application as granules (see series of papers in *Proc. Br. Insecticide Fungicide Conf. 1961*, **1**, pp. 93-134 and Rothamsted annual reports). Fluoracetamide was compared with other insecticides by Barry Williams (*Tech. Bull. Harper Adams. agric. Coll.* BDHA/1, 1959, 15 pp.). Treatment of seed with systemic insecticides as well as of soil was also being tried (Gates, *Ann. appl. Biol.* 1959, **47**, 492-501) and led to present recommended practices.

Hull has already given detailed accounts of the outbreaks for 1957-61 (*Pl. Path.* **7**, 131; **8**, 145; **9**, 151; **10**, 149; **11**, 183) and has summarized some of the loss data from 1946-62 inclusive (*Pl. Path.* 1963, **12**, 155-6). The following information has been largely gleaned from Hull's reports, and the reader is directed to the latter for the data on yield losses. More recently it has been thought that the losses were probably smaller than had been estimated, as it appeared that beet mild yellowing virus had been of far greater importance in Britain than beet yellows virus during these, as well as other, years (Russell, *Ann. appl. Biol.* 1963, **52**, 405-13).

In 1957, exceptionally early infection followed heavy infestations by overwintered green aphids. Before June was over, some whole crops were infected, and in July others became suddenly yellowed. On average, 75 per cent of plants in the east and south-east had yellows by the end of August, but less than 20 per cent was present in most crops in Yorks, Lincs, the Midlands and the west. The calculated loss of root yield for 1957 was greater than any previously recorded.

The stormy weather in June 1958 limited incidence and few crops became uniformly yellow that year. About 100,000 acres of sugar beet were sprayed,

and the average yield of roots was the heaviest recorded in Great Britain, although the sugar content was low.

In the three seasons 1959-61, crops were infested by aphids early on and spraying in late May was advised. Spraying with systemic insecticides in each season effectively decreased or delayed incidence. In spite of the long dry spells favourable to aphids in 1959 the high sugar yield was a record. The average yield of roots, 13·4 tons per acre had been exceeded in Britain only in 1958. The first half of 1960 was largely warm and dry, and the summer and autumn wet. Growth was favoured and the average yield was the highest to that date. Yellows developed late, and spraying, and numerous predators and parasites, checked the large aphid populations. By the end of the season yellows was more prevalent in some areas of the south, west and north than in East Anglia—the reverse of the usual distribution. In 1961 infection was widespread by autumn. The yield of roots of 14·48 tons per acre had been exceeded only in 1960 but the average sugar content was low.

Russell distinguished the unrelated sugar beet yellows (SBYV) and sugar beet mild yellowing (SBMYV) viruses, and studied their distribution and interrelationships in East Anglia in 1955-60 (*Ann. appl. Biol.* 1958, **46**, 393-8; ibid. 1960, **48**, 721-8; *Pl. Path.* 1962, **11**, 14-6). His experiments showed that SBYV was not always the major cause of virus-induced chlorosis in sugar beet. He found a wide range of SBYV strains to be present in E. Anglia in 1959. According to Russell (*Rep. Pl. Breed. Inst. 1963-4*, 20-7) 1957 and 1959, together with 1955, were the apparent exceptions to the conclusion that in most of the years 1955-63, BMYV was far more common than BYV in eastern England.

In addition to developments in the use of insecticides (see above) other advances were being made.

Considerable interest in breeding beet cultivars tolerant to yellows continued: lines selected at Dunholme Station for their performance in spite of yellows were made available to breeders in 1957. Material tolerant to both of the yellowing viruses was soon ready for exploitation in the general breeding programme for the improvement of sugar beet at the Plant Breeding Institute (Russell, *Br. Sugar Beet Rev.* 1960, **28**, 163-70 and annual reports of the Institute).

The importance of overwintering aphids in mangel clamps and stores prompted investigations on fumigation of clamps with methyl bromide (Dunning *et al.*, *Proc. Br. Insecticide Fungicide Conf. 1961*, **1**, 135-6) and on reduction of sprouting with *gamma* radiation (Cornford and Powell, *Nature, Lond.* 1957, **180**, 996). Gibbs (*Ann. appl. Biol.* 1960, **48**, 771-9) found no evidence in East Anglia in 1958 and 1959 of spread of yellows from wild beet to nearby sugar beet crops. Baker (ibid. 384-91) showed that aphids fed preferentially, bred more rapidly and lived longer, on yellows virus-infected leaves than on healthy ones.

Mosaic (beet mosaic virus) was not of great consequence. A few eastern localities variously reported a little more than usual in 1957, 1960 and 1961. In 1960 some attacks were severe near mangel crops in the Spalding area of Lincs.

Harrison (*Ann. appl. Biol.* 1957, **45**, 462-72) recorded a previously undescribed, mechanically transmissible, virus, beet **Ring Spot**, which occurs naturally in Scotland in sugar beet and other crops. He showed the virus to be

a strain of tomato black ring virus (*J. gen. Microbiol.* 1958, **18**, 450-60). Various aspects of the rather rare beet **Yellow Net** virus were studied by Watson and Chessin (*Rep. Rothamsted exp. Stn, 1958*, 99).

Docking Disorder, so named because it was originally noted in the vicinity of Docking, W. Norfolk, has now been recognized for about 20 years. According to Gibbs (*Pl. Path.* 1958, **8**, 93-4) incidence varies from year to year. It was particularly prevalent in 1958, being reported from Yorks, Salop, Lincs, Norfolk and Suffolk. Gibbs and others had suggested that soil conditions were likely to be a major factor: it has since been established that docking disorder is restricted to sandy soils low in organic matter content and that this is an outstanding characteristic. The problem is complex and probably still not fully understood. Of the several factors said to be involved the most common appears to be the free-living eelworms (*Trichodorus* and *Longidorus* species) as reported by Whitehead (*Br. Sugar Beet Rev.* 1965, **34**, 77-8, 83-4 and 92).

Strangles follows injury to the hypocotyls of young seedlings, and is associated with various factors. In 1958 it was prevalent in some factory areas in the Midlands and east, and in 1959 followed black leg in several instances. Several areas reported strangles in 1960 and 1961, and it was more widespread than usual in the latter year. Experiments in the east of Scotland (Boyd, *Br. Sugar Beet Rev.* 1958, **26**, 161-4) emphasized the importance of the effect of disturbance or exposure by singling at an early stage. **Acid Soil Injury** was reputed (Hull, *Sugar Beet Diseases*, 1960, *Bull. Minist. Agric. Fish. Fd* 142, p. 3) to be the most important seedling trouble of sugar beet in Britain. Hull (*Jl R. agric. Soc.* 1961, **122**, 101-12) has commented that it is more common in some springs (e.g. 1961) than others.

In the 1960/61 season in the south-west, **Splitting** of crowns with **Hollow Heart** followed excessive growth in the generally wet summer and autumn. At a Yorks factory in 1958, many beets with multiple crowns, not unlike symptoms of eelworm damage, were handled, 250 acres being slightly affected. The crowning caused a central hollow which filled with water and tended to allow rotting in the centre of the root itself. In 1959 W. J. Byford reported an apparently new disease, **Neck Rot.** During June and July, 39 crops affected with this trouble were notified to Dunholme; mostly in S. Lincs, Notts, Cambs and W. Norfolk, but also in Worcs. According to Byford (*Rep. Rothamsted exp. Stn, 1959*, 194), the rotted roots became hollow immediately below the crown; and shrinking, furrowing or splitting often followed. Affected plants, usually less than one per cent of the crop and scattered through the fields, ultimately wilted and died. Fungi weakly parasitic to adult beets, *Phoma betae* and *Fusarium* sp., invading tissue injured earlier, possibly by frost, were thought to be responsible. Further information from Byford indicated a varietal effect, Hilleshög cultivars being particularly involved.

The effects of the weather were sometimes noted, for example the drought of 1959, and there was the odd instance of **Lightning Injury,** but the most interesting examples came in May 1958 when the Dunholme Station received several enquiries about **Frost Injury** to beet seedlings although no serious frost had been recorded. Isolated seedlings or patches were affected. Reports from Dunholme revealed that all affected seedlings had fully expanded cotyledons, and first leaves about 2-6 mm long. Damage varied from slight

tipping to death of the aerial parts. Often hypocotyls were normal but root development poor. Affected tissues were usually light brown, dry and papery. If the cotyledons were only partly affected, seedlings usually recovered. Outbreaks were widely distributed in Worcs, Notts, Lincs and Norfolk; and most were on low-lying land and on silt or very fine sand. The first trouble arose when the soil was very dry. Meteorological Office records showed that although there were occasional ground frosts at night, no ground-level temperatures below -3°C were actually recorded. This trouble had not been noted in previous years even when frosts were more severe although, according to the Dunholme Station, frost injury to beet is well-known on peaty and low-lying fields. It was thought that the relatively high day temperatures at this time might possibly have predisposed the plants to frost damage in 1958. Affected crops recovered as the weather improved.

According to *Rep. Rothamsted exp. Stn, 1960* (p. 223), **Hormone Spray Injury** occurred in 1960 in numerous sugar beet fields by drift from cereal spraying or the use of contaminated machines when spraying beet. Several crops in other years were severely damaged by herbicides.

In 1961, Hull commented (*Jl R. agric. Soc.* 1961, **122**, 101-12) that in sugar beet crops, deficiency diseases were now very rare but that, with the greater use of fertilizers, trace element deficiencies had increased, From the reports received at Dunholme from the factory areas, it appeared that over the 5-year period, symptoms of deficiency diseases were recorded on the following approximate average acreages: magnesium deficiency, 29,000; manganese deficiency, 26,000; boron deficiency, 11,000. In contrast, **Potash Deficiency** was seen on an average of little over 2,500 acres.

Speckled Yellows (manganese deficiency) was particularly prevalent in 1958 and 1960. It was above average in 1958 and 1959 in I. of Ely but many crops were successfully sprayed. **Magnesium Deficiency** was much more prevalent in 1960 and 1961 than in the other years; while **Heart Rot and Dry Rot** (boron deficiency) were particularly noticeable in 1959 and 1961.

Mangel

Clamp Rots were attributable to several fungi. *Botrytis cinerea* Fr. caused a few severe attacks in most years, and *Pleospora björlingii* Byford was reported on a number of farms, particularly in the Northern Region in the 1959/60 winter and in the West Midland Region the following season. On a Derby farm on which most roots were rotted in February, *Fusarium* was abundant on all rotted areas but no pycnidia could be found; however, isolations from the borders of healthy and diseased tissues near the crown and tail yielded only *P. björlingii*. Loss amounting to 80 per cent of a crop occurred in a clamp in Beds and was due to *Fusarium* sp.: the roots had been lifted during a dry period, topped within 24 hours and were handled carefully. Another cause of clamp rot was *Phytophthora* sp., samples being received from a deteriorating clamp of cv. Red Intermediate in Worcs in May 1958.

Outbreaks of **Black Leg** associated with fungi, involved *Pleospora björlingii* Byford, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., *Aphanomyces* sp. and *Pythium* sp. *C. solani* caused losses, some of which were heavy, during dry seed-bed conditions in S. Wales in the springs of 1957 and 1958

and further trouble was experienced there in 1959 and 1961. *Pythium* was involved in an outbreak in Yorks which necessitated the resowing of the field and there were many attacks by *Pythium* etc. in Devon in 1960, a low pH being involved in two of the cases investigated.

Seed crops were fairly heavily affected by **Downy Mildew** (*Peronospora farinosa* (Fr.) Fr. f.) *betae* Byford) in the Spalding area in May 1958, but only the odd report came from elsewhere. **Powdery Mildew** (*Erysiphe betae* (Vañha) Weltzien) reached 50 per cent infection in crops in an area in Hants in 1959 while sugar beet was affected only to 5 per cent. Attacks of **Leaf Spot** (*Ramularia beticola* Fautr. & Lamb.) were numerous in Devon and Merioneth in autumn 1958, but this widely distributed disease was not of general importance. Both it and **Leaf Spot** (*Cercospora beticola* Sacc.) were favoured by the humid weather in 1958 in the south-west. Some severe **Rust** (*Uromyces betae* Kickx) infections were noted in S. Wales in 1957.

Violet Root Rot (*Helicobasidium purpureum* Pat.) was noted on several occasions, and also reported were **Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn).

Mangel crops can be an important source of overwintering infection for **Virus Yellows** in sugar beet (discussed on p. 49). Incidence in mangel seed crops can be high in the east, for instance in 1958 most were 100 per cent infected in the Spalding area and yellows was very bad in I. of Ely. The disease was often prevalent in mangels in the south-west. **Mosaic** (beet mosaic virus) was noted.

Strangles and **Black Leg,** attributed to non-parasitic causes, affected some crops, and the former was unusually common in the Evesham Area in 1958, frequent in Yorks E.R. in 1959 and reported from various parts of the east Midlands in June 1960. **Heart Rot and Dry Rot** (boron deficiency) was frequently observed in mid-Wales in 1959, especially on soils subject to drought, and again in 1960: it causes considerable losses on many farms. In the 1959/60 season it was very widespread in S. Wales with losses severe both in the field and subsequently in storage. Other reports came from S. Wales during the five years. In 1961, symptoms of this trouble appeared in numerous crops in the south-east and were common in Devon and Cornwall. Symptoms of **Stringy Root** were seen in crops on three farms in the south-west in 1958 and were attributed to soil texture and mineral deficiencies; in single crops in Worcs in 1958 and Dorset in 1961 the symptoms were associated with acid soil. A scurfiness of the tops of 'bulbs', associated with large depressions around the circumference, was seen in several samples in the south-west in 1958 and, as in earlier years, was associated with low K/N ratios. **Lightning Injury** affected a 10-yard patch in a crop in the south-east in 1957. The odd case of **Chimaera** (plants with variegated leaves) was noted.

Turnip and Swede

Club Root (*Plasmodiophora brassicae* Woron.) was regularly troublesome in Wales and crop failures were no rarity; indeed many farmers in Anglesey and Caerns were giving up swedes and turnips to rely mainly on the relatively

club-root free kale. Crops throughout Wales, and in the south-west, suffered more than usual in 1958. The disease was prevalent during the five years in Devon and unduly troublesome there in 1957 and 1961: red-land crops in the county are frequently sold for human consumption and price assessments were reputed to have been made difficult in 1959 by club root. A disease survey, in 1961, of 30 swede crops confirmed club root as the cause of the most serious losses throughout the Devon red-soil area and in S. E. Cornwall. In the extreme north, 1957 was the worst year. Reports of the prevalence, and sometimes severity, of club root were received from other areas growing swedes and turnips during these years. Attacks were sometimes encountered in land free from brassicas for many years, for example in two west Midland swede and turnip fields, the first crops after 37 and 30 years respectively of grass. Willey, Davies and Morgan (*Pl. Path.* 1961, **10,** 28-31) found apparent resistance in a number of swede cultivars in trials from 1953-57, and Gray (*Scott. Agric.* 1959, **38,** 208-9) reported that certain Dutch and Belgian turnip cultivars did well on infected land in Scottish trials. Norman *et al.* (*Ann. appl. Biol.* 1959, **47,** 364-6) obtained useful results with pure-calomel treatments of swede seeds. Crops in Wales were surveyed in 1956 by Taylor and Morgan (*Pl. Path.* 1958, **7,** 61-3). Other literature on club root relevant to this period is mentioned on p. 79.

Dry Rot and Canker (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) was quite common in swedes in Wales throughout the period. In S. Wales development in clamps was considerable in 1957, 1960, and 1961; in 1960 it was prevalent also in the growing crops but in 1957 was rarely seen in the field. The outstanding year in N. Wales was 1961—up to about this time club root had been considered to be the major disease of swedes and turnips in Caerns and Anglesey but, although widespread infections by *Plasmodiophora* were still being recorded in the early 1960's, visits to numerous farms for experimental work on club root led to the opinion that dry rot was more widespread and generally causing greater damage. Outside Wales reports were sparse, but dry rot was recorded frequently in the Northern Region in 1958, and was again troublesome in the south-west in 1960 on farms where swedes were being grown without rotation. In a survey of diseases in Devon and Cornwall in 1961, *Plenodomus* was seen on only one of the 30 farms.

Little **Powdery Mildew** (*Erysiphe cruciferarum* Junell) was seen until late in the season in each of the years 1957, 1958 and 1960. In contrast, 1959 brought widespread and very heavy attacks in all Regions; it was, however, often impossible to decide how far the poor yields were caused by mildew rather than the extensive and simultaneous aphid infestation. A rapid survey around Newcastle by the N.A.A.S. showed that though severely mildewed plants became completely defoliated, the leaf scars healed normally and the roots remained sound in the field, and no abnormal losses in storage were notified. Following the country-wide epidemic of 1959, cooperative work between the N.I.A.B. and the N.A.A.S. was started in 1960 to try to assess the effect of swede mildew in causing yield losses.

In 1961 nearly the whole of the Northumb swede crop was affected and a few attacks were heavy in Yorks N.R. but, in the rest of Yorks and in Lancs, infection was late and apparently little damage resulted. In the West Midland Region mildew developed during July and August to a greater degree than

1. Leaves of soybean affected by downy mildew (*Peronospora manshurica*) (pp. 61, 226).

2. Red Craigs Royal potato leaves showing the yellow ring spots attributed to tobacco rattle virus (p. 39).

PLATE I

Cucumber fruit and leaves showing symptoms caused by cucumber green mottle mosaic virus (pp. 90, 241), mottling of the fruit and leaves and blistering of the leaves.

PLATE II

for several years and was prevalent in early September in turnip and swede. Early-sown crops in Norfolk were severely mildewed too. In trials in the south-west, 70 swede cultivars were all severely affected by the mildew.

Tomlinson and Webb (*Nature,Lond.* 1958, **181,** 1352-3) found that the addition of zinc to soil suppressed turnip mildew and they made further studies with zinc (*Rep. Veg. Res. Stn, Wellesbourne, 1959,* 43; ibid, *1960,* 49-50).

Reports of **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) were infrequent, except from Wales, and severity was rarely apparent anywhere. **White Spot** (*Cercosporella brassicae* (Fautr. & Roum.) Höhnel) was reported on a number of occasions. High humidities favoured it in the south-west in 1958, some swede crops being badly defoliated. In 1961, leaf spots were present in nearly all of 30 swede crops surveyed in Devon and Cornwall, but did not affect vigour: the commonest one was white spot. In 1961, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was associated with symptoms of strangles in swedes in Som: the fungus caused lesions and the condition was new to the South-western Region. **Common Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) appeared in the odd turnip crop in 1959; and also noted during the period, in Wales, were **Grey Mould** (*Botrytis cinerea* Fr.) in clamps and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn).

Soft Rot (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) occurred in varying amounts in swedes, being more particularly noticeable in some areas in 1960. Factors influencing incidence were attacks of swede midge, frost damage, and splitting or cracking associated with growing conditions. On a farm in Brecon two crops of cv. Angus were precision-drilled and each received 8 cwt of a complete fertilizer, one field also receiving 40 tons F.Y.M./acre, the other only 10 tons/acre: the former suffered 60 per cent loss due to soft rot the latter about 2 per cent.

Turnip Yellow Mosaic virus was confirmed in Herefs in 1960. Although strains had been found in crucifers in widely scattered areas in Britain before this period began, it had seemed not to be prevalent. Lister (*Pl. Path.* 1958, **7,** 144-6) reported it in eastern Scotland in 1956 but found little effect on the yield of roots in field trials. **Turnip Rosette** virus (possibly with **Turnip Crinkle** virus) was confirmed by A. G. Walker and R. Lysons in a turnip crop at Kentchurch, Herefs in 1960. Neither rosette nor crinkle had been recorded up to that time in England and Wales though they were known to occur in Scotland (Broadbent, A. R. C. Series No. 14, 1957, *Investigation of Virus Diseases of Brassica Crops,* Cambridge University Press; Lister, *Pl. Path,* 1958, **7,** 144-6). Symptoms of crinkle appeared in the last week of October 1961 in N.I.A.B. trials at Headley Hall, Yorks W.R.: the swede cultivars Wilhelmsburger and Bangholm showed severe symptoms but with no apparent effect on size of roots. Lister (*loc. cit.*) had found little effect by crinkle on yield in field trials in Scotland. Broadbent and Heathcote (*Ann. appl. Biol.* 1958, **46,** 585-92) discussed the above three flea-beetle transmitted viruses with an account of their properties and host range. Symptoms believed to be due to **Cauliflower Mosaic** virus were noted in a small number of swede plants in a survey in Devon and Cornwall. The previously undescribed **Beet Ring Spot** virus occurs naturally in Scotland in both turnips and swedes (Harrison, *Ann. appl. Biol.* 1957,

45, 462-72): Harrison's experiments (*J. gen. Microbiol.* 1958, **18,** 450-60) indicated that this virus is a strain of tomato black ring virus.

Brown Heart (boron deficiency) was well above normal throughout S. Wales in the 1957/8 winter and seemed particularly prevalent on the Old Red Sandstone soils. The condition was very widespread in swedes in this area in 1959/60 and caused severe losses in the field and subsequently in storage; it was not uncommon in the other years but less than usual appeared in the 1958 crop. The value of many swede and turnip crops in mid-Wales was very considerably reduced in 1959. In 1961 the symptoms were commonly seen in Devon, Cornwall, Bucks, Hants and I.W. The seasonal, non-parasitic, **Cracking** or **Splitting** was widespread in the Northern Region in 1957 and presumably attributable to wet weather following a long dry spell. Often the cracked tissue callused over but in this year, and in 1960 and 1961, soft rots sometimes set in. Cracking was locally troublesome on green-top swedes in the Yorks and Lancs Region in the 1957 crop. Few other comments on cracking and splitting were made. Symptoms, not associated with pathogens, noted in many of the 30 swede crops surveyed in Devon and Cornwall in 1961 were bad shape, extreme 'neckiness' of the plants and cracking of the roots. Many samples from various swede crops in Wales in 1957 showed **Hybridisation Nodules. Strangles** (non-parasitic) appeared not to be troublesome.

Kale and Rape

In N. Wales, where **Club Root** (*Plasmodiophora brassicae* Woron.) was still the major disease of brassicae and sometimes very severe, kales were generally free and were replacing turnips and swedes on many farms. Crops were affected more than usually in mid-Wales in 1958, in the South-western Region in 1960, and in the East Midland Region in 1961. In a crop husbandry trial in Som the rape-kales, hungry gap and asparagus, and the dwarf kale cv. Canson were affected in January 1960 while thousand-headed, Scots green curled and cv. Chou de Cholet kales were not. Published work on club root on brassicas in general is discussed on p. 79.

Downy Mildew (*Peronospora parasitica* (Fr.) Fr.) had an occasional mention in reports. In autumn 1961 it was severe in Devon and Cornwall and in many instances killed out seedlings of late-sown kale crops; kale had generally been sown late in those counties and probably the weather particularly favoured the fungus at the seedling stage. On an Anglesey farm where kales were sown on several different dates it was the latest sowings (mid-July) which were the worst affected. **Dark Leaf Spot** (*Alternaria brassicae* (Berk.) Sacc.) was prevalent in places in the south-west in 1958 with death of lower leaves, but this fungus and *A. brassicicola* (Schw.) Wiltsh., although noted, appeared not to be troublesome. Some losses were caused by **Ring Spot** (*Mycosphaerella brassicicola* (Duby) Oudem.) in the extreme south-west.

More **Foot and Root Rot** (*Phytophthora* sp.) was seen in the south-west in 1960 than is usually the case. Attacks confirmed or suspected as caused by *P. megasperma* Drechsl. were noted in Kent, Berks, Wilts, Som and Cards. Badly drained soils were said to be associated in some instances.

In one of the two attacks in Berks, 30 per cent of the crop was infected by this species in February 1958. Other fungus diseases reported only occasionally were **Powdery Mildew** (*Erysiphe cruciferarum* Junell), which was severe in a few rape crops, **Dry Rot** (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.), **White Blister** (*Albugo candida* (Hook) O. Kuntze) and **Wire Stem** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.). Half a crop of rape grown for 'cress' in Middx was lost because of **Damping-off** associated with *Pythium* and *Rhizoctonia*.

Soft Rot (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) caused more than average losses in mid-Wales in 1960 and severe losses in kale crops in south-western counties in 1958. In plots of marrow stem kale in Devon the June-sown plots were much more severely affected than those sown in April. Thousand-headed kale was affected in a Wilts trial when other kales were little affected. At Seale Hayne Agricultural College, Newton Abbot, losses were very severe when 80 per cent of the plants in a 4-acre field collapsed by February 1958: a high nitrogen status and excessively soft growth led to stem cracking and leaf shedding and the bacterium entered through the cracks and leaf scars. Stem splitting followed by secondary rotting was noted in one or two other crops and attributed primarily to weather. **Black Rot** (*Xanthomonas campestris* (Pamm.) Dowson) was well above average in prevalence in Devon and Cornwall in 1958.

Cauliflower Mosaic and **Cabbage Black Ring Spot** (a strain of turnip mosaic) viruses were both reported from trials with kales in the south-west. **Boron Deficiency** was recorded in a number of crops in S. Wales, and the only other non-parasitic trouble noted was death of kale plants in a square patch in a crop of kale in Worcs attributed to **Lightning Injury.**

Diseases of Pulse

Field and Broad Beans

Chocolate Spot (*Botrytis fabae* Sardiña, and the less important, *B. cinerea* Fr.) was of little significance except in the wet year of 1958 when attacks were widespread and generally severe in much of the Eastern Region. In 1958, some eastern counties experienced more than for a number of years, yields being affected appreciably and many winter sowings completely defoliated; but, in spite of the wet weather, yields in most other parts of the country were not greatly affected. In 1960, chocolate spot developed too late to have any serious effect on yield. Studies on the development of infection, and on factors influencing infection of bean plants by *Botrytis*, have been conducted by Deverall (*Trans. Br. mycol. Soc.* 1960, **43,** 462-3) and by Deverall and Wood (*Ann. appl. Biol.* 1961, **49,** 461-72 and ibid. 473-87). The latter authors found that *B. fabae* caused lesions more readily than did *B. cinerea*. Buxton, Last and Now (*J. gen. Microbiol.* 1957, **16,** 764-73) investigated some effects of ultraviolet radiation on the pathogenicity of *B. fabae*, and also of *Uromyces viciae-fabae*, to broad bean, and Napier *et al.* (*J. Sci. Fd Agric.* 1957, **8,** 467-74) the systemic action of captan for control of chocolate spot.

Sclerotinia Disease (*Sclerotinia trifoliorum* Erikss. var. *fabae* Keay) was hardly observed in 1957, 1959 and 1961. Its effects were slight in the Eastern Region in 1958 and 1960, except for some locally serious attacks in East Anglia, and a few reports only were received from elsewhere in 1960. **Leaf Spot** (*Ascochyta fabae* Speg.) (Plate XIV) was recorded once or twice in most years; but **Foot Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) rarely, and **Rust** (*Uromyces viciae-fabae* (Pers.) Schroet.) was also scarce though it appeared in considerable amounts in trial plots at Rosemaund Experimental Husbandry Farm in Herefs in 1957. No reports of **Leaf Spot** (*Cercospora zonata* Wint.) were received during these five years.

The first reports of bean **Leaf Roll** virus were given by Tinsley (*Pl. Path.* 1959, **8,** 17-8): affected broad bean plants had been noticed at Rothamsted in 1955 and again in 1956 and 1957. Tinsley reported that symptoms had been seen in these years in many crops of peas and field beans in south-east England. In the east Midlands, virus infection was severe in some field bean crops in 1959, and several viruses including bean leaf roll and bean mosaic (see below) were present. Bean leaf roll became widespread in July 1960 in the east Midlands, and in 1961 was again seen in many crops in that Region. Bean leaf roll, **Pea Mosaic** and **Pea Enation Mosaic** viruses were the only three viruses found by Heathcote and Gibbs (*Pl. Path.* 1962, **11,** 69-73) to be common in British crops of field beans during 1959, 1960, and 1961, though many other viruses were known to affect this plant: most plants became infected late in the season in these years. Bean leaf roll virus appeared to be the most important of the three economically.

Gibbs (*Rep. Rothamsted exp. Stn, 1960,* 119) found plants infected with

the seed-borne true **Broad Bean Mosaic** virus in crops of broad beans in several places in south England in 1960: most crops had 0·1 per cent or less of plants infected, but a few had up to 10 per cent. Seed, which is imported principally from North Africa, was suspected to be the source of infection. This virus was found to be widespread in crops of cvs. Aquadulce Claudia and Mammoth in the Vale of Evesham in 1960. The occurrence of **Broad Bean Stain** virus in England in 1959 and 1960 is referred to on p. 224.

A severe internal blackening of broad bean pods has been seen in Worcs and Hants in one or two instances: half a crop was affected in 1959. The whole of the woolly lining was blackened, collapsed and 'greasy', but the pod tissue proper and the seeds were quite normal. The cause was not known, but perhaps the dry growing conditions that year may have occasioned a withdrawal of water from these tissues.

French Bean

In 1956 a fungus whose characters agreed with **Leaf Blotch** (*Ascochyta boltshauseri* Sacc.) was found on runner beans in Suffolk (J. Bundy, pers. comm.) and was said to have occurred on other beans elsewhere in East Anglia. Previous to this, the only record was of a similar fungus which appeared on dwarf beans in Norfolk in 1953. Again, in September 1958, specimens of dwarf beans cv. Refugee sent to me from Norfolk, were found to have been attacked by this fungus. Typical lesions occurred on many pods but a striking and extensive brown flecking was also present and may have been due to some other cause. Over half of the plants were affected by these combined symptoms, involving about 1½ acres of the crop. In examining material from these 1956 and 1958 outbreaks the present author found that, in common with *A. boltshauseri*, the fungus involved had a fair proportion of multiseptate pycnospores and in this more nearly esembled species of *Stagonospora*. Reports on further outbreaks which occurred in 1960 were sent to me by H. J. Wilcox: between August and September, eight crops of cv. Blue Lake climbing French beans were severely damaged in Kent, yields being reduced, sometimes considerably. Over half the yield was lost in one 14-acre crop, in which infection was noted soon after germination. In this, and in another outbreak in a crop elsewhere from the same seed, there was some evidence that the fungus had been present in the seed. Dwarf or runner beans were infected at three other sites in 1960, and in one, a private garden, there was a complete loss. In all these attacks plenty of pycnidia with the large type of spore were found on all parts of plants including pods.

Anthracnose (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav.) was above average in dwarf beans in Suffolk in 1958, being fairly widespread and sometimes severe. In 1959 it was above normal in Yorks and Lancs. Several other outbreaks were reported. Reports of **Foot Rot** (*Fusarium solani* (Mart.) Sacc. f. *phaseoli* (Burkh.) Snyder & Hansen) on dwarf and climbing beans came in occasionally, and sometimes *Rhizoctonia* was associated with the *Fusarium*. Climbing beans, cv. Blue Lake, were severely affected in one area in Kesteven (Lincs) in 1961. **Fusarium Wilt** (*Fusarium oxysporum* Fr.) was noted in the odd crop in eastern counties.

Sclerotinia Disease (*Sclerotinia sclerotiorum* (Lib.) de Bary) appeared in a number of glasshouse crops, and in 1960 in a few dwarf and climbing bean crops in the east of the country. Seventy per cent of plants in four acres of cv. The Prince dwarf beans were wilted in Surrey. There was serious loss of a glasshouse crop in the Yorks and Lancs Region, the first time the fungus had been reported on the host in this Region. Several hundred climbing bean plants in three glasshouses in the Wye Sub-Region were killed by *Sclerotinia:* the soil of these houses had been treated with formalin, but in adjacent houses in which the soil had been treated with metham-sodium, losses were negligible.

Black Root Rot (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted, and **Rust** (*Uromyces appendiculatus* (Pers.) Unger) was occasionally severe, particularly on cv. Blue Lake climbing beans, in East Anglia in 1957 and 1958.

In 1957, **Halo Blight** (*Pseudomonas phaseolicola* (Burkh.) Dowson) caused considerable losses, at a number of centres in the South-eastern Region, in cv. Refugee dwarf bean grown under contract for canning. The disease spread epidemically in dwarf beans in Worcs in 1958 in late June and early July: following the previous wet harvest much seed had to be saved which would normally have been discarded. The further bad harvest of 1958 led to above average attacks in Yorks and Lancs and the South-eastern Region in 1959, but in the Evesham Area, although halo blight appeared early, progress was arrested by the dry weather. Exceptionally severe attacks in climbing beans appeared in Norfolk in 1960: while in 1961, following heavy rain in mid-June, the disease appeared in many crops in the Evesham Area by the end of June, but was only occasionally severe, particularly so where the crop had been irrigated.

A sample of white dwarf bean seed of East German origin, undergoing a health examination for export at Plant Pathology Laboratory, Harpenden in 1958 was found to be infected with **Wilt** (*Corynebacterium flaccumfaciens* (Hedges) Dowson). Infected beans showed a slight yellow discoloration around the hilum region and dried bacterial ooze was visible at the hilum itself. The organism was isolated and its identity confirmed in culture by R. A. Lelliott. Wilt has never been recorded on bean crops in Great Britain. Several plants of climbing beans in Sussex had **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) in 1957.

Symptoms of **Mosaic** (bean common mosaic virus) became widespread in several crops of cv. Blue Lake climbing beans in Norfolk in 1959 and were more common that year in the Eastern Region than for some time. Mosaic and bean **Yellow Mosaic** symptoms were noted in a number of crops and confirmations made in a few: these viruses were probably quite common. Virus infection was widespread in crops grown for quick-freeze in the East Midland Region in 1959.

Runner Bean

The first outbreaks of **Leaf Blotch** (*Ascochyta boltshauseri* Sacc.) on runner beans, and also on French beans, are discussed under French beans. **Anthracnose** (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav.) was very prevalent throughout crops in E. Norfolk in 1958 but otherwise reported

only occasionally. **Foot Rot** (*Fusarium solani* (Mart.) Sacc. f. *phaseoli* (Burkh.) Snyder & Hansen) was found in a number of crops. As usual there were moderate or severe local attacks of **Fusarium Wilt** (*Fusarium oxysporum* Fr.) in Beds, and crops in the Evesham Area were occasionally affected. Crops in Worcs were said to be severely affected in 1960, and the disease to be widespread, but losses were not serious. A few reports originated in the south-west in 1961. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) appeared in one or two crops in the south-east; **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted, and **Rust** (*Uromyces appendiculatus* (Pers.) Unger) was severe in the occasional crop in Kent. On one Kent holding the early runner bean cv. Lightning was said to suffer from rust much more severely each year than the later-maturing cv. Streamline. The, rarely reported, aecidial stage of the fungus was found in Dorset in 1958. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was confirmed in a crop in Kent. **Halo Blight** (*Pseudomonas phaseolicola* (Burkh.) Dowson) became epidemic in the Evesham Area in 1958 and 1960; in the latter year it had spread by July to most plants in many crops but it was less prevalent on dwarf beans. Some of the 1959 crops had above normal outbreaks following the sowing of the poor 1958-harvested seed but the dry weather did not favour later development. Many complaints were received in the South-eastern Region in 1960, and in several instances the effects of the disease had been considerably aggravated by soaking the seeds before sowing. Crops in Beds were moderately severely affected in 1960, and occasional attacks were severe in the Evesham Area in 1961.

Soybean

From Suffolk in 1959 came the first record for this country of **Downy Mildew** (*Peronospora manshurica* (Naum.) Syd.) (Plate I, 1). The outbreak was found by Kingsley (*Pl. Path.* 1960, **9**, 38) and the disease confirmed by the present author. The seed from which the crop was grown, supplied from U.S.A., probably carried the fungus, though this could not be confirmed on a small quantity of seed left over after sowing. Severe infection appeared in a plot of cv. Bansei but no infection could be found in another, less vigorous cultivar Panda, long grown on the nursery. In 1960, mildew was widespread throughout another crop grown on the same farm but from a new lot of seed, bought from the same source as in the previous year. The infection was, however, light and did no practical damage.

Pea

Perhaps, potentially, the most economically important disease of peas, **Downy Mildew** (*Peronospora viciae* (Berk.) Casp.) was fairly widespread in parts of the Eastern Region in all years, except 1957 when severe cases were rare. Severe or moderately severe attacks were noted in some eastern areas in 1958 and 1960 but in 1959, although mildew was common in the seedling stage in some crops in the Fens, the dry weather checked development. In 1961, many of the fenland crops which were heavily infected earlier in the season, made good recovery later. Some crops of cv. Harrison's Glory

were badly affected in the east Midlands in 1957, and occasionally severe attacks were noticed in other Regions during these years. A small N.A.A.S. survey in I. of Ely during 1959 emphasized the importance of soil-borne infection. Attempts to control the disease with fungicides met with very limited success and because of its importance plans were made for joint investigation by the Pea Growing Research Organisation, Yaxley and the National Vegetable Research Station.

Although in some areas **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *pisi* (Lindf.) Snyder & Hansen and *F. redolens* Wr.) has proved an important disease, it was only occasionally severe during the years under review. It had been first recognized in this country only a few years before this period (Buxton and Storey, *Pl. Path.* 1954, **3,** 13-6). There were several reports in 1958 and 1960 but very few in the other years, indeed in the Eastern Region it was said to be almost absent in 1959 and 1961. In 1960 pea wilt was serious, apparently for the first time, in N. Glos.

It became apparent that hopes of combatting wilt lay with the breeding of resistant cultivars: most of the popular cultivars were found by Buxton, Doling and Reynolds (ibid. 1959, **8,** 39-45) to be susceptible. Later (ibid. 1960, **9,** 54-6) they tested further cultivars and new selections. The mechanism of variation in this fungus was being studied at Rothamsted.

Buxton (*Nature, Lond.* 1958, **181,** 1222-4) reported a host-induced change in pathogenicity in races of the fungus. He showed (*Trans. Br. mycol. Soc.* 1957, **40,** 145-54) that root exudates from different pea cultivars can affect races in different ways, and made further studies (ibid. 305-17; *J. gen. Microbiol.* 1960, **22,** 678-89) on effects of exudates and of rhizosphere micro-organisms on the fungus. Work on the extent of pathogenic interactions between this fungus and *F. solani* on peas was done by Buxton and Perry (ibid. 1959, **42,** 378-87); and Perry (ibid. 388-96) dealt with possible mechanisms underlying the interactions. Conclusions on the mode of infection in peas grown from seed were made by Hepple (*Nature, Lond.* 1960, **185,** 33-4). Buxton (*Rep. Rothamsted exp. Stn, 1961,* 118) began work on the application of chitin to the soil as a possible means of controlling pea wilt.

An isolate obtained by Buxton (*Nature, Lond.* 1959, **184,** 1258) after ultraviolet radiation of cultures, was thought by him to be the perfect stage of *Fusarium oxysporum* f. *pisi* and he referred to it as *Nectria haematococca* Berk. & Br. (=*Hypomyces solani* Rke. & Berth. emend Snyder & Hansen). Gordon (ibid. 1960, **186,** 903) considered that Buxton's isolate constituted the first record of the perfect stage of *F. solani* f. *pisi.* However, Snyder and Alexander (ibid. 1961, **189,** 596) concluded that the isolate was neither the perfect stage of *F. oxysporum* f. *pisi* nor of *F. solani* f. *pisi* and suggested it to be a homothallic saprophyte with an imperfect stage in *F. solani.* In their opinion no perfect stage was yet known for any colony of *F. oxysporum* nor for any clone of the pea root and stem rot form of *F. solani* f. *pisi* (but see p. 226).

Fusarium Foot Rot (*Fusarium solani* (Mart.) Sacc. f. *pisi* (Jones) Snyder & Hansen) was the most common pea disease in the Eastern Region in 1958, a feature probably associated with the very wet conditions in many fields. This trouble was present in many crops in the west Midlands and the Eastern Region in 1960 and 1961. In Essex, in 1961, several crops were

devastated just as they were coming into pod and no pods were picked. Bywater (*Trans. Br. mycol. Soc.* 1959, **42,** 201-2) studied infection of peas by *F. solani* f. *pisi* (=var. *martii* forma 2), and the spread of the pathogen.

In 1958, **Leaf and Pod Spot** (*Ascochyta pisi* Lib.) was reported to be widespread in Essex but was seldom severe and, in 1960, there were a few moderately severe outbreaks there. This disease, and **Foot Rot** (*Phoma medicaginis* Malbr. & Roum. var. *pinodella* (L. K. Jones) Boerema syn. *Ascochyta pinodella* L. K. Jones; and *Mycosphaerella pinodes* (Berk. & Blox.) Vestergr.) were noted in a few other crops only, though the two latter fungi were troublesome in the Yorks and Lancs Region in 1958, and *M. pinodes* in the Eastern Region in 1961. According to the annual reports of the Pea Growing Research Organisation, Yaxley, *Ascochyta* spp. were common on many crops of threshed peas at harvest time in 1957, 1958 and 1960. Seed treatments using fungicides, or heat treatment with carbon tetrachloride, for reducing or eliminating *M. pinodes*, were tried by Maude (*Rep. natn. Veg. Res. Stn, 1959* to *1961* inclusive). Fumigation of pea seed as a possible means of controlling *Ascochyta* was investigated by Kennedy (*J. Sci. Fd Agric.* 1961, **12,** 96-103), and chloropicrin showed potentialities.

Root Rot (*Aphanomyces euteiches* Drechsl.) was unusually plentiful in Yorks and Lancs in 1958. Root rots in general were widespread in the east Midlands that year, brought on no doubt by excessive wetness of soils: the overwhelming majority of samples were severely infected with *A. euteiches* and only occasionally *Thielaviopsis basicola*. When *Aphanomyces* was present, the whole or most of the crop was usually affected; whereas in the absence of this fungus, when waterlogging alone was responsible, affected plants appeared in distinct patches. Cropping with peas encouraged the activity of the fungus which was apparently troublesome on old arable fields. Where cvs. Kelvedon Wonder and Lincoln were grown alongside one another, the former was the more severely affected. In contrast, crops in the east Midlands were very free from foot and root troubles in the next three seasons. Surprisingly little was seen in the Eastern Region in 1958 despite the wet weather, though troubles associated with wet soils brought many below-standard crops. The very wet soil conditions of the winter in this Region early in 1961 probably led to the many instances of foot and root rots that followed, a number of which were attributable to *Aphanomyces*. Crops in the Evesham Area experienced frequent and often severe attacks by this fungus in May 1961. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was a very occasional cause of root rot, while oospores of a species of *Pythium* were often found in roots of samples from I. of Ely in 1958 when foot rotting was considerable over large areas of waterlogged fields, or patches of fields, in that area. Species of *Pythium* are involved in pre-emergence **Damping-off** in peas. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted on a number of occasions, and was troublesome in the Eastern Region in May 1961. Several cultivars, particularly Witham Wonder, suffered considerable foot and root rotting in Kent in June 1958 and *T. basicola* was the only fungus isolated.

After a virtual absence from reports in 1957 and 1958, **Powdery Mildew** (*Erysiphe pisi* St.-Am.) was devastating in one late crop in September 1959 in Worcs and reported to be widespread and severe on other late crops in the county. That year brought attacks, worse than for many years,

in the Eastern Region. There were a few moderately severe attacks in Essex in 1960 and mildew was present, though not serious, in several Suffolk crops. The widespread attacks in 1961 in late-sown crops in the west Midlands led to some crops being unsaleable because of pod infection. Several pod samples affected with **Grey Mould** (*Botrytis cinerea* Fr.) were received from Holland (Lincs) and I. of Ely, in 1961. **Sclerotinia Stem Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was reported by Gray and Findlater (*Pl. Path.* 1960, **9,** 130-2) in July 1957 in three pea crops in S. Kincardineshire, and was noted again in 1958; by 1959 it was found to be present on about five per cent of the plants in all the pea-growing areas of that Scottish county. The disease had not been recorded before in Great Britain. Bywater and Hickman (*Trans. Br. mycol. Soc.* 1959, **42,** 513-24) described a new variety of *Phytophthora erythroseptica* Pethybr. which they had isolated from pea roots: the fungus was responsible for a soft rot of the roots. *Phytophthora* spp. have rarely been recorded as occurring naturally on peas in Britain.

The virus diseases **Mosaic** (pea mosaic virus) and **Leaf Roll** (bean (pea) leaf roll virus) were noted in crops. According to A. J. Gibbs (pers. comm.) little mosaic but a lot of leaf roll was seen in 1959. Hagerdorn (*Tijdschr. PlZiekt.* 1958, **64,** 263-8), in a survey of 14 pea fields mainly in Essex, Norfolk and Hunts, recorded, in addition to mosaic and **'Top Yellows'** (bean leaf roll virus), **Enation Mosaic** (pea enation mosaic virus), **Streak** (pea streak virus), and **Stunt** (clover red vein mosaic virus). Enation mosaic and streak were very much in evidence in this survey. **Bean Yellow Mosaic** virus was also known to occur in peas during the period under review.

During the dry summer of 1959, scattered plants or groups of plants, discoloured brown or purple, were seen in some pea crops over a wide area in places as far apart as the Vale of Evesham and the east coast of Norfolk. The condition was much less evident in 1960, but in the comparatively dry 1961 season, symptoms were again noted in many pea fields, particularly in East Anglia. Mr. J. D. Reynolds and Dr. D. A. Doling, who reported the condition (pers. comm.), described the symptoms as follows:

'Pod symptoms were the most striking feature. At the green harvesting stage several, and sometimes all, pods of affected plants turned light-brown to purple and either failed to fill, eventually withering away, or else assumed a rubber-like texture, the peas inside being of a dull grey or 'sad' appearance. Necrotic lesions of the same colour range frequently occurred on stems, petioles and peduncles as well. Many plants showed general chlorosis and in some cases the apical foliage developed a wrinkled or 'scorched' appearance.'

Similar symptoms seen in other countries have been attributed to viruses of the pea streak-inciting type, of which a number of forms are known to exist (Kim and Hagedorn, *Phytopathology*, 1959, **49,** 656-64), and it was thought that at least one streak-inciting virus was responsible for these outbreaks in England.

No mention was made of **Marsh Spot** (manganese deficiency) in reports other than in 1961 (*Rep. Pea Grow. Res. Org. 1961*, 10), but Noble (*Proc. int. Seed Test. Ass. 1961*, **25,** 536-8) encountered appreciable amounts of the condition **Hollow Heart** along with typical marsh spot, when examining seed for sowing in Scotland in 1959. Hollow heart was noted in England in

1961 (*Rep. Pea Grow. Res. Org. 1961*, 10). Excessive wetness and high humidities produced **Oedema** (non-parasitic) of the young leaves of many crops in the east Midlands in 1958. In May 1958, approximately 30 per cent of the plants in a field in Suffolk were stunted and bore thickened leaves lacking in bloom. The affected plants were scattered through the crop which had been drilled early in April, too short a period (two weeks) after treatments with the herbicide TCA.

Diseases of Pasture, Forage Crops, Rushes and Turf

Clover

Rot (*Sclerotinia trifoliorum* Erikss.) appears to have been at a generally low level in most of the country throughout this period. The several severe attacks which developed in some Eastern Region counties in the 1957-8 and 1958-9 winters were mainly local or in individual fields. In Moore's *British Parasitic Fungi* (p. 347) clover rot is described as virtually unknown in Wales and south-west England: while there were no reports from Wales in 1957-61, the disease was confirmed in five crops of broad red clover in the Exeter area of Devon in February 1957, and early in 1958 was again noted in Devon. Quite severe damage was also reported to first-year lucerne crops in the Starcross Sub-Region in 1960. Seventy per cent of an English stock of broad red clover was affected in Suffolk in a field on which no clover had been grown during the four years prior to sowing. On a farm in Glos, about 10 per cent of plants in one half of a field had been killed, though the disease was practically absent from the other half: an association with rotting of the sclerotia due to high nitrogen, in line with the findings of Justham and Ogilvie (*Ann. appl. Biol.* 1950, **37,** 328) was suggested as poultry had grazed the latter half of the field in the previous autumn.

Surveys for clover rot made in 1953-55 in England and Wales (Lester and Large, *Pl. Path.* 1958, **7,** 115-24) revealed its presence in about 70 per cent of the fields examined in 1953 and 1954 (years in which incidence was considered to be about normal) and in about 50 per cent of those examined in 1955. *Coniothyrium minitrans* Campb., pathogenic to sclerotia of *S. trifoliorum* was recorded for the first time in England by Tribe (*Trans. Br. mycol. Soc.* 1957, **40,** 489-99) who also studied its natural distribution on sclerotia.

Only Caerns and Glos were cited in reports of **Anther Mould** (*Botrytis anthophila* Bondartzev), wild red clovers being affected, but it occurs widely in red clover crops though difficult to find. Noble (*Pl. Path*, 1957, **6,** 38) found a high proportion of the red clover seed samples of the 1955 English harvest to be infected. **Black Blotch** (*Cymadothea trifolii* (Killian) Wolf), usually of little significance, appeared in a few reports in most years. It had killed leaves to an appreciable extent in a white clover crop in Hants in 1959, and another quite severe attack on white clover was seen in Berks the following year. Most of the other records of this fungus came from Wales. In 1959, **Powdery Mildew** (*Erysiphe trifolii* Grev.) was general on red clover in Yorks in September, exceptionally severe in the South-eastern Region especially on red clover, and attacks were frequently heavy in the west Midlands on wild clover in the autumn. Some newly-sown crops in the Eastern Region were heavily affected in autumn 1961. Several bad attacks of **Scorch** (*Kabatiella caulivora* (Kirchn.) Karak.) occurred in seed crops on the Welsh border of the West Midland Region in 1958, and the disease was present throughout a field of red clover in I.W. in 1961 but otherwise was barely noticed. **Downy Mildew** (*Peronospora trifoliorum* de Bary) was locally noticeable in Lancs in 1959, and in Wales from time to time, but

drew few other comments in advisers' reports. In a field in Denbigh, alsike clover was affected while broad red clover was not. The widespread **Leaf Spot** (*Pseudopeziza trifolii* (Fr.) Fuckel) was particularly common in 1960 in some Welsh localities. **Rust** (*Uromyces trifolii* (DC.) Lév.) was noted in a few crops in Cards and once in Glam.

Black Stem (*Phoma medicaginis* Malbr. & Roum. var. *medicaginis* syn. *Ascochyta imperfecta* Peck) was said to be on rotting stem bases of clover plants wilting in patches in a crop in Devon in August 1957. According to Moore (*Br. Parasitic Fungi*, p. 65) the fungus has been found previously on white clover. Toovey, Waterston and Brooks had earlier succeeded in inoculating red clover with an isolate from lucerne (*Ann. appl. Biol.* 1936, **23,** 705-17); however, Boerema (*Neth. J. Pl. Path.* 1965, **71,** 79-89) considers that, in the Netherlands and America, while black stem of red clovers is similar to that in lucerne it is always distinguished from it *in vitro*.

New on clover in this country, **Verticillium Wilt** (*Verticillium* sp.) was found in 1959 on Dorset Marl red clover at Trawscoed, Cards. In 1961, plants of this same clover, in a field in I.W. showed symptoms similar to those caused by *Kabatiella caulivora* though this fungus could not be detected. However, isolations from markedly discoloured vascular tissue in the crown yielded *Verticillium dahliae* Kleb. This fungus was isolated also from plants in a white clover ley in I.W. in the same year. Roberts (*Pl. Path.* 1963, **12,** 138) described pathogenicity tests to red and white clover with an isolate of *V. dahliae* from the I.W. outbreak on red clover. Isolates of *V. alboatrum* and *V. dahliae* from lucerne were found not to be pathogenic to red clover (Isaac and Lloyd, *Ann. appl. Biol.* 1959, **47,** 673-84).

Other leaf diseases, **Ring Spot** (*Stemphylium sarciniforme* (Cav.) Wiltsh.), **Mid-vein Spot** (*Mycospharella carinthiaca* Jaap) and **Burn** (*Leptosphaerulina trifolii* (Rostr.) Petr.) seemed unimportant, judged by the absence of comment in reports.

Although not included in earlier bulletins in this series, the **Phyllody** condition had long been recognized in, particularly white, clover. Only recently had the cause been attributed to the virus (clover phyllody virus) responsible for green petal in strawberry (Frazier and Posnette, *Ann. appl. Biol.* 1957, **45,** 580-8). Phyllody appeared to have increased in recent years. During 1957-8, reports indicated its prevalence in parts of the Midlands and mid-Wales and, in 1958, concern was expressed by grassland advisers at its increasing prevalence in white clover seed crops in East Anglia. The following year 23 crops were intensively surveyed by Carr (*Rep. Welsh Pl. Breed. Stn, 1959*, 61-3), and extensive surveys, continuing until 1962, commenced on all white clover seed crops entered for certification in England and Wales. Methods for assessing the disease quantitatively were devised by the Disease Assessment Committee of the N.A.A.S. Conference of Plant Pathologists and used to give supplementary, more intensive, results in 1961-2. The whole survey was reviewed by Carr and Large (*Pl. Path.* 1963, **12,** 121-7): phyllody was found to be widespread in all areas of white clover seed production (mainly E. Anglia, west Midlands and Lincs (*loc. cit.*, Fig. 1)) and was in at least 40 per cent of the crops. Those of the wild white type had less than those of large-flowered cultivars. Phyllody was shown to have accounted for over five per cent direct loss of seed production in about one in eight of the first-year crops of S100 in 1961, and in about one in four

of second-year crops of S100 in 1962. Red clover was much less affected. Work on the disease at the Welsh Plant Breeding Station during this period is discussed in the Station Reports from 1959, and also (by Ellis Davies) in *Pl. Path.* 1964, **13,** 40–3.

A condition referred to as **Red Leaf** (*Stolbur virus*) was prevalent in white clover at the Welsh Plant Breeding Station in 1959 (Ellis Davies, *loc. cit.*). Carr (*Rep. Welsh Pl. Breed. Stn, 1959*, 61-3) found 'red leaf' in all but one of the 23 crops he examined in East Anglia in 1959: he also found another virus yellows disease, **Witches' Broom** (clover witches' broom virus), in seven of them. A virus disease, **Clover Mottle** (clover (red) mottle virus), was identified in plants examined in 1957 at Rothamsted (Sinha, *Ann. appl. Biol.* 1960, **48,** 742-8; ibid. 749-55. **Arabis Mosaic** virus occurs naturally in white clover (Harrison and Cadman, *Nature, Lond.* 1959, **184,** 1624-6) and, according to Gibbs and Tinsley (*Pl. Path.* 1961, **10,** 61-2), **Alfalfa Mosaic** virus is widespread in red and white clovers in Britain. Carr (*Proc. 8th Grassland Cong. 1960*, 200-4) has discussed the significance of virus diseases in herbage crops generally.

Methods for controlling **Broomrape** (*Orobanche* spp.) were being sought (Ellis Davies, *Pl. Path.* 1959, **8,** 19-22).

Lucerne

The outstandingly serious **Verticillium Wilt,** (Plate XIII, 2) caused by a strain of *Verticillium alboatrum* Reinke and Berth., was unknown in Britain until 1950 when it was found in Scotland, and 1952 when it was identified in East Anglia (Noble, Robertson and Dowson, *Pl. Path.* 1953, **2,** 31-3). By the end of 1957 its presence in the Midlands, the east, south-east and south-west of England was known and the disease appeared to be on the increase. *V. dahliae* was isolated from infected plants from Montgomery in 1957. A national survey of lucerne crops by the N.A.A.S. Plant Pathologists was started in 1958 and continued into 1960 (Roberts and Large, *Pl. Path.* 1963, **12,** 47-58). Wilt was shown to be present in all Regions but to be particularly prevalent and severe in the east and south-east, where most lucerne is grown. In the cooler, wetter, years 1958 (*loc. cit.*, Fig. 1) and 1960, more wilt was recorded than in 1959 which was warm and dry. About 30 per cent of the crops in their first harvest year had wilt with about 3 per cent substantially infected, compared with about 70 per cent of crops in their fourth harvest year with about 40 per cent substantially infected. No practical differences of susceptibility among cultivars was found. Introduction of the disease with seed was a possibility in about one third of the crops. In 1961 wilt was again widely distributed in the East Midland Region but it seemed less severe than in previous years, while in the Eastern Region it was about average in fields known to be infected; there was a limited number of reports from elsewhere and wilt was newly recorded in the Starcross Sub-Region. Isaac (*Ann. appl. Biol.* 1957, **45,** 550-8) found *V. alboatrum* to be the main species involved; and recorded *V. dahliae* for the first time, in a single instance at Cambridge. He detected *Verticillium* in debris carried with seed, while Davies and Isaac (*Nature, Lond.* 1958, **181,** 649) suggested that airborne spores can also spread the disease. All strains of lucerne used by Zaleski (*Pl. Path.* 1957, **6,** 137-42)

were attacked, but Carr (*Rep. Welsh Pl. Breed. Stn, 1959*, 64-6) found considerable differences between certain species of *Medicago* in the proportion of resistant plants. Isaac and Lloyd (*Ann. appl. Biol.* 1959, **47**, 673-84) studied host range, the seasonal cycle and host-parasite relations. Their preliminary work with seed dressings was followed by that of Isaac and Heale (*Ann. appl. Biol.* 1961, **49**, 675-91) who used dressings containing mercury, thiram or captan, and also certain fumigants. Isaac (*N.A.A.S. q. Rev.* 1959, No. 46, 75-9) summarized the current knowledge.

Black Stem (*Phoma medicaginis* Malbr. & Roum. var. *medicaginis* syn. *Ascochyta imperfecta* Peck) caused no concern judging by the minimal reports, and it was found in only one or two fields each season in the verticillium wilt survey, 1958-60. A record in the Yorks and Lancs Region was claimed to be the first from there. **Anthracnose** (*Colletotrichum trifolii* Bain and Essary) was recorded in less than 10 per cent of crops surveyed for verticillium wilt and there were no serious losses. A severe wilt in a first-year crop in 1957 was the first record of this fungus for the South-eastern Region: several affected crops were noted in 1957 and 1958 in the south-east. Infection occurred in stands 1-5 years old, and up to five per cent infection was noted in a few places. In 1958 stalk break was quite common in the Eastern Region, and it was thought that the symptoms in the foliage could be confused with those of verticillium wilt. In a crop of Chartrain-villiers, sown in 1956, 75 per cent of the stems were affected by August 1958, and there was another very bad attack in a 1957-sown crop of this cultivar. The disease was widespread in Salop in 1958, causing much stem break. Other slight to moderate attacks in these years, and in 1959 and 1960, were encountered to the south of the Midlands and in Wales. **Downy Mildew** (*Peronospora trifoliorum* de Bary) was present in quite a number of crops in the first annual inspection of the verticillium wilt survey but there were no serious losses. Most crops in Norfolk and the South-eastern Region had some mildew in 1958. It was not infrequent in the Wye Sub-Region in 1960 but never on more than two per cent of the stems. Other known attacks were widely scattered. The common **Leaf Spot** (*Pseudopeziza medicaginis* (Lib.) Sacc.) was very prevalent locally in the South-eastern Region in 1957, several crops being temporarily quite severely affected. In 1958 it was found, though usually on lower leaves and of little importance, in all crops examined in the Wye Sub-Region after about six weeks from planting, being more common in September than July. In 1960 it was very much in evidence in Devon and Cornwall. Other observations indicated the frequency with which the fungus occurs; for instance, most crops examined during the 1958-60 verticillium wilt survey had some infection and, although leaf spot is not generally of great concern, some severe attacks resulted in defoliation. **Rot** (*Sclerotinia trifoliorum* Erikss.) appeared in many parts of the country; it caused quite severe defoliation in some first-year stands in the east Midlands in 1959 and in the Starcross Sub-Region in 1960; and, in several west Midland attacks in 1961, plants were killed even in established stands. This disease was notably virtually absent from the South-eastern Region except in a number of first-year stands. During the 3-year verticillium wilt survey, clover rot was only very occasionally seen, **Crown Wart** (*Physoderma alfalfae* (Lagerh.) Karling) was noted in 7-9 crops each year, over half of them being in the south-west. A number

of other reports of this disease were received. It was rarely extensive but a 20 per cent infection was recorded from Devon with many plants killed.

Violet Root Rot (*Helicobasidium purpureum* Pat.) appeared once or twice; in Hants the perfect stage was present. **Leaf Spot** (*Pleospora herbarum* (Fr.) Rabenh.) was mentioned very infrequently.

The finding of **Rust** (*Uromyces pisi* (DC.) Otth syn, *U. striatus* Schroet.) in four lucerne crops in Sussex (Dale, *Pl. Path.* 1960, **9,** 111-2), and in one in Kent, in 1959, was noteworthy. In Sussex it was common in six acres of cv. Du Puits sown in May the same year. Previously the fungus had been recorded once only on lucerne, in Suffolk in 1957 (Butler, *Trans. Br. mycol. Soc.* 1958, **41,** 401-4). The rust is known on trefoil, and on one or two wild species of *Medicago*, in this country. Glasscock and Ware (*Trans. Br. mycol. Soc.* 1946, **29,** 167-9) recorded its discovery in seven acres of trefoil in 1945, where, as far as could be judged, every plant was infected; in that instance the fungus could not be found on an adjoining lucerne crop. Also in 1945, it was recorded in some experimental plots of trefoil in Som. *U. pisi* is world-wide where lucerne is grown (*C.M.I. Distribution Maps of Plant Diseases*, 1957, No. 342, Ed. 1*). In 1956, Carr (*Pl. Path.* 1957, **6,** 38) found a fungus causing symptoms in lucerne similar to those of burn in white clover, at the Welsh Plant Breeding Station. He regarded it as *Sphaerulina trifolii* Rostr.† (syn. *Pseudoplea trifolii* (Rostr.) Petr. previously recorded in Britain only on white clover.

The 1959 survey by Gibbs (*Pl. Path.* 1962, **11,** 167-71) showed that **Lucerne Mosaic** (alfalfa mosaic virus) occurs in lucerne crops in all parts of Britain, being commoner in older and smaller crops. He found the virus in 52 of the 76 crops sampled, incidence being similar in different parts of the country. Symptoms in naturally and artificially infected plants were described by Gibbs and Tinsley (*Pl. Path.* 1961, **10,** 61-2). Symptoms caused by **Pea Leaf Roll** virus were often seen, during the verticillium wilt survey, in the Wye Sub-Region in 1960.

Sainfoin

Leaf Spot (*Ascochyta orobi* Sacc.) was again seen in Glam; and **Rust** (*Uromyces pisi* (DC.) Otth syn. *U. onobrychidis* Bubák) was noted in a few places in Wales, and in Berks, in 1959 and 1960. Young plants suffered from **Damping-off** (*Pythium* sp.) on a Northumb farm in 1958; *Pythium* had not previously been reported as associated with sainfoin diseases in this country.

Trefoil

Black Stem (*Phoma medicaginis* Malbr. & Roum. var. *medicaginis* syn. *Ascochyta imperfecta* Peck) was confirmed in Suffolk. Though this disease and **Leaf Spot** (*Pseudopeziza medicaginis* (Lib.) Sacc.) were rarely mentioned in reports they are likely to have been common. **Rot** (*Sclerotinia trifoliorum* Erikss.) was seen in a few crops.

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* Ed. 2, 1968.

† *Leptosphaerulina trifolii* (Rostr.) Petr.

Vetch

Chocolate Spot (*Botrytis* sp.) was present on lightly spotted leaves in a crop in Devon examined in April 1958, the plants having primarily been damaged by frost. **Downy Mildew** (*Peronospora viciae* (Berk.) Casp.) considerably damaged a crop, and **Rust** (*Uromyces viciae-fabae* (Pers.) Schroet) was noted in another, in Montgomery in 1957.

Comfrey

A slight attack of **Powdery Mildew** (*Erysiphe cichoracearum* DC.) appeared in a crop of Russian comfrey in Yorks W.R. in 1959; previously this disease had been seen in Suffolk in 1956. **Rust** (*Melampsorella symphyti* Bubák) was noted in a trial in Hants in 1959.

Grasses

Many advisers sent reports of **Ergot** (*Claviceps purpurea* (Fr.) Tul.) on ryegrass, and there were records concerning cocksfoot, timothy, meadow fescue, meadow foxtail, blackgrass, couch grass and tall-oat grass. A field of sea twitch (*Agropyron pungens*) was affected in the Maldon district of Essex in 1957, and *Nardus* sp. in Brecon in 1959. In 1958, areas in which infection was noticeably common on grasses generally were the East Midland and South-eastern Regions, Suffolk, Glos, mid- and South Wales: in Flints four fields, totalling 20 acres, of ryegrass showed sparse heads, of which 80 per cent carried sclerotia. In 1957, records were very few, while in 1959 there were hardly any except from Wales where ergot was frequent on late flowering perennial ryegrass and couch grass in hedge-banks. Farmers in S. Wales were expressing concern about the widespread distribution.

The disease was common in grasses generally in the Eastern Region in 1960 and in Yorks W.R., Devon, Cornwall and mid-Wales in 1961. In four instances in these years mycotic abortion was diagnosed in cattle which had fed on affected leys or pastures. Several sheep died on one farm, numbers were poisoned on two others, and a pig died on yet another, after feeding on infected material. Because of the risks to stock in grazing infected pastures, Jenkinson (*Pl. Path.* 1958, 7, 81-5) examined the occurrence of ergot and development of infection in grasses in south-west England.

In 1959, **Choke** (*Epichloe typhina* (Fr.) Tul.) was reported by the South-eastern Region Grassland Officer to be much more prevalent than of recent years in cocksfoot seed stands inspected for certification, being especially prevalent in the Whitchurch area of Hants. In 1958 and 1961 it was common in old cocksfoot stands in Essex, and in the latter year was more severe than usual in the South-eastern Region. In one seed crop heavily infected in Suffolk, yield was probably reduced from 6-8 to 2 cwt/acre. Several other severe attacks were reported on cocksfoot and, in Pemb, choke was noted on couch-grass. Western and Cavett (*Trans. Br. mycol. Soc.* 1959, **42**, 298-307) presented evidence that choke is not transmitted with cocksfoot seed and showed that the invasion of stubble through cut ends by germinated spores is the most probable source of

field infection. A note on choke in creeping fescue (*Festuca rubra*), in which species transmission with seed is highly effective, was published by Harberd (*Rep. Scott. Pl. Breed. Stn, 1961*, 47-51). Host-parasite relations in this disease were studied by Kirby (*Trans. Br. mycol. Soc.* 1961, **44**, 493-503).

Take-all (*Ophiobolus graminis* (Sacc.) Sacc.) was seen mainly on ryegrass, but noted also on cocksfoot, meadow and tall fescues, Yorkshire fog and bent-grass. In one or two instances infection was severe. In 1960 it was frequent in Lancs but not damaging. Doling and Hepple (*Pl. Path.* 1959, **8**, 73-5) recorded this disease in several cocksfoot seed crops and in a crop of timothy in Holland (Lincs) in 1957, and discussed the possible significance of seed crops of ley grasses in the carry-over of take-all to cereals.

Leaf Fleck (*Mastigosporium rubricosum* (Dearn. & Barth.) Sprague) has been severe in a number of cocksfoot crops. It was common in mid-Wales in most years, very much so in 1958 and 1959. In four crops of cocksfoot (S26 and S143), kept for winter grazing in the west Midlands in 1957, fleck was severe and contributing to death of leaves; the crops were made unpalatable to stock. In a cocksfoot/ryegrass ley in Yorks N.R. in 1961, cocksfoot was more severely affected than ryegrass. Moore (*Br. Parasitic Fungi*) did not list ryegrass as a host of this fungus. There was a severe attack on common bent-grass in Merioneth in 1957, caused presumably by *M. rubricosum* var. *agrostidis* Bollard. A preliminary study (Carr, *Rep. Welsh Pl. Breed. Stn, 1961*, 101-3) on the effect of *M. rubricosum*, selected as an example of an endemic leaf spot on grass, on productivity of cocksfoot, indicated a greater influence on the host than had been suspected. **Leaf Fleck** (*Mastigosporium album* Riess) of meadow foxtail was noted in two crops in Cards.

Crown Rust (*Puccinia coronata* Corda var. *lolii*) was common on ryegrass in mid-Wales in 1957 and 1959. Except for 1959, reports came almost entirely from Wales or the south-west where the rust was usually prevalent, though reports were almost absent in 1960. Only in 1959 did crown rust come into special prominence in the Midlands and south-east. In September it was severe on ryegrass in the east Midlands especially in Northants, and it was prevalent in the Evesham area on ryegrass, being severe in 10 acres of permanent grass. Severe outbreaks appeared in most counties of the South-eastern Region. In a cultivar trial in Hants, examination on 15 September showed that English strains were more heavily infected than Continental ones. A noticeable feature was the more green colour and apparent reduced rust infection of 'cowpat' areas, with higher nitrogen. *P. coronata* var. *holci* was noted on Yorkshire fog in Cards: Brown (*Ann. appl. Biol.* 1937, **24**, 504-27), had earlier noted this variety of the rust in this country.

Other grass rusts noted were **Cocksfoot Rust** (*Uromyces dactylidis* Otth) which was very common in some counties in mid-Wales in 1959 and appeared in other Welsh reports and in Worcs and **Yellow Rust** (*Puccinia striiformis* Westend.*) which was severe throughout 20 acres of S37 cocksfoot in Worcs in 1961, and was noted in cocksfoot in Wales.

* See comments on the rust on cocksfoot in Wilson and Henderson's *Br. Rust Fungi*, p. 299.

Manners (*Trans. Br. mycol. Soc.* 1960, **43,** 65-8) described *P. striiformis* var. *dactylidis*, a race which is confined to cocksfoot, and reported it on English and Irish material. **Black Stem Rust** (*Puccinia graminis* Pers.) was reported also on cocksfoot, couch-grass, tall oat-grass and timothy, all these records being from Wales. In Scotland, forms of *P. graminis* had earlier been distinguished on these grasses (Batts, *Trans. Br. mycol. Soc.* 1951, **34,** 533-8). The aecidial stage of *Puccinia festucae* Plowr. was abundant on a patch of roadside honeysuckle (*Lonicera periclymenum*) near Aberystwyth in June 1957.

The common **Smut** (*Ustilago avenae* (Pers.) Jens.) of tall oat-grass was particularly common in mid-Wales in 1961, while **Sheath Smut** (*Ustilago hypodytes* (Schlecht.) Fr.) was recorded on ryegrass in Yorks W.R.—a new record for this Region.

Wilcox (*Pl. Path.* 1960, **9,** 113) made the first record in Britain of **Leaf Blotch** (*Rhynchosporium orthosporum* Caldwell) on *Lolium;* this was in S22 and H1 strains of Italian ryegrass in E. Sussex in 1960 and the fungus had affected much of the crop by April. This species of *Rhynchosporium* was first reported in Britain by Owen (*Pl. Path.* 1952, **1,** 122), the host then being cocksfoot. Wilcox's note also records the finding, by I. G. Thorpe, of *R. orthosporum* on Italian ryegrass, cocksfoot and *Agrostis stolonifera* in an old ley in Wilts in April 1960; the record on the bent-grass was also the first for Britain. Severe "tipping" of the foliage, due to this fungus was noticeable in several crops of Italian ryegrass in Devon and Cornwall in the springs of 1960 and 1961 but the crops soon recovered. Both *R. orthosporum* and **Leaf Blotch** (*Rhynchosporium secalis* (Oud.) Davis) were present in a crop of Italian ryegrass in Dorset in 1961. Considerable damage by *R. secalis* on Westerwolths ryegrass in Wilts in spring 1960 was described by Thorpe in *Pl. Path.* 1960, **9,** 113, in which he mentioned that N. C. Preston had found the fungus in 1955 in a crop of Italian ryegrass in Salop: these were the first reports of *R. secalis* on ryegrass in this country. In the attack in Wilts loss of leafage caused particular concern as the crop had been relied upon to give early spring grazing. A whole field of New Zealand Short Rotation perennial ryegrass in Devon showed tipping of the foliage that same spring, and another crop of Italian ryegrass was affected in Dorset in 1961. Physiologic specialization in *R. secalis* has been studied by Owen (*Trans. Br. mycol. Soc.* 1958, **41,** 99-108).

Ascochyta graminicola Sacc. was noted on ryegrass but the fungus is presumed to be of little consequence. **Twist** (*Dilophospora alopecuri* (Fr.) Fr.) was seen in Cards on cocksfoot, while **Powdery Mildew** (*Erysiphe graminis* Mérat) on cocksfoot was widespread in that county in May 1958 and there were other reports of it on ryegrass and cocksfoot. Patches of a permanent pasture were dying in Sussex because of **Red Thread** (*Corticium fuciforme* (Berk.) Wakefield) in 1960, and **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was noted in 1960 in very gappy plots of meadow fescue at the Welsh Plant Breeding Station. **Snow Mould** (*Calonectria nivalis* Schaffnit) was reported on ryegrass, and **Ear Blight** (*Fusarium equisiti* (Corda) Sacc.) was found at W.P.B.S. in 1957 and this was thought to be a new record for Wales. Gray and Nicholson (*Trans. Proc. bot. Soc. Edinb.* 1957, **37,** 123-8) identified *C. nivalis* on bent-grass species, perennial ryegrass and rough meadow-grass in upland pasture in

various localities in north Scotland: the effect of snow mould appeared to be important in the development of semi-natural *Agrostis—Festuca* grassland. The influence of microbial antagonisms on the occurrence of *F. culmorum* in soil and roots of ryegrass in swards of this grass was investigated by Griffiths and Siddiqi (*Nature, Lond.* 1958, **182,** 956.) **Silver Top** (*Fusarium tricinctum* (*Corda*) Sacc. f. *poae* (Peck) Snyder & Hansen) caused very serious losses in two cocksfoot seed crops in the east Midlands in 1961 and the accompanying mite *Pediculopsis graminum* was identified; loss was also very serious in a seed crop of timothy adjacent to one of them. **Blind Seed Disease** (*Gloeotinia temulenta* (Prill. & Delacr.) Wilson, Noble & Gray) was mentioned in a few reports from the north but no doubt continues to be common throughout the country. It was common in ryegrass seed samples examined for export health certification at Plant Pathology Laboratory, Harpenden. Griffiths studied sexual reproduction and variation (*Trans. Br. mycol. Soc.* 1958, **41,** 461-82) and cytology (*Trans. Br. mycol. Soc.* 1959, **42,** 132-48) in this fungus. Methods of inoculation (*Res. exp. Rec. Minist. Agric. Nth. Ire.* 1958, **8,** 8-16) and bulk production of spores (ibid. 1958, **7,** 1-7) for use in inducing large-scale epiphytotics in connection with breeding programmes have been studied by Wright, and Wright and Wilson, respectively.

Leaf Spot (*Helminthosporium phlei* (Graham) Scharif*) was described in detail by Scharif (*Trans. Br. mycol. Soc.* 1961, **44,** 217-29). In 1955 a *Helminthosporium* on timothy had been seen at Cambridge and in many of the timothy seed samples examined at N.I.A.B. (*Rep. natn. Inst. agric. Bot. 1955,* 22). No reports of this disease were received from advisers during the period under review. In ryegrass, **Leaf Spot** (*Drechslera siccans* (Drechsl.) Shoemaker) was abundant in single fields in Staffs, Worcs and Devon in 1958, and affected yields. A record of **Leaf Stripe** (*Helminthosporium* sp.) on cocksfoot in Caerns in 1960 was of interest as this grass did not appear to have been recorded previously as a host of *Helminthosporium* in this country. **Leaf Spot** (*Heterosporium phlei* Gregory) of timothy, first noted in 1950 (Devon) by G. H. Brenchley and not seen since in England and Wales, was identified in an S48 seed crop in Montgomery in 1961. **Black Leaf Spot** (*Phyllachora graminis* (Fr.) Fuckel) and **Halo Spot** (*Selenophoma donacis* (Pass.) Sprague & C. G. Johnson) were both noted in cocksfoot crops. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) severely attacked potted plants of Italian and perennial ryegrasses at the Welsh Plant Breeding Station in 1958. **Leaf Spot** (*Ramulaspera holci-lanati* (Cav.) Lind.) was newly recorded for Britain in the Aberystwyth area on Yorkshire fog in 1954 and 1955 (Griffiths, *Trans. Br. mycol. Soc.* 1957, **40,** 232-6).

A **Slime Mould,** *Mucilago spongiosa* Morgan, was recorded on grass specimens in Cornwall. A species of *Neurospora*, probably *N. sitophila* was prevalent in February 1958 in 200-300 tons of silage composed of chopped ley grass. The silage was originally covered with farmyard manure but was later exposed along the cut edge. When the silage was fed to animals, allergic reactions were produced.

Viruses were for long present in British grasses without being recognized,

* Now *Drechslera phlei* (Graham) Shoemaker.

and it is only recently that much has been known about their effects or their epidemiology. **Cocksfoot Streak** virus was first identified in England, indeed in Europe, by Smith (*Pl. Path.* 1952, **1,** 118). Slykhuis (*F.A.O. Pl. Prot. Bull.* 1958, **6,** 129-34) found the virus, where cocksfoot is commonly grown, in almost every district surveyed during 1956 in England, Wales and Scotland. In 1954 it was much more prevalent than usual in the South-eastern Region. Carr (*Rep. Welsh Pl. Breed. Stn, 1959,* 63-4) found that in swards with 100 per cent infection, yield was 60 per cent lower than in healthy stands. The effects of streak virus on the growth of cocksfoot were assessed by Catherall and Griffiths (*Pl. Path.* 1961, **10,** 72-7) and the possibility of different strains of the virus indicated. Infection with **Barley Yellow Dwarf** virus in grasses was first established in timothy from Wales and England, and ryegrass from England, in 1956 (Watson and Mulligan, *Pl. Path.* 1957, **6,** 12-14; Slykhuis, *F.A.O. Pl. Prot. Bull.* 1958, **6,** 129-34). The grass host range of British isolates of BYDV was studied by Watson and Mulligan (*Ann. appl. Biol.* 1960, **48,** 559-74). The N.A.A.S. Plant Pathology Department at Bristol made routine tests on grasses from the neighbourhood of infected oat fields. Infection was confirmed in meadow fescue, red fescue, cocksfoot, rough meadow grass, *Phleum nodosum* and couch. Slykhuis (*loc. cit.*) found **Ryegrass Mosaic** (he referred to it as "ryegrass streak mosaic") virus in all areas surveyed in England, Wales and Scotland in 1956. This disease was noticeably common in some areas of the South-eastern Region in 1959. The transmission by mites, the host-range and properties of the virus were investigated by Mulligan (*Ann. appl. Biol.* 1960, **48,** 575-9). One or two timothy heads per 1,000 showed **Vivipary** (proliferation of spikelets) in a crop in the Starcross Sub-Region in 1958, and as well-advanced inflorescences were subjected to short days, a photoperiod effect was suspected. One or two other examples of proliferation were noted in timothy.

Rushes

Only two diseases of rushes were dealt with by advisory pathologists during these five years: both were on specimens of *Juncus* from a site in Glam. Of interest was the identification of **Rust** (*Uromyces junci* (Desm.) Tul.) on these plants. Wilson and Henderson (*Br. Rust Fungi*, p. 355) have commented that this rust is almost confined to Yorks and some eastern counties, though the aecidial stage had been found at Reading. The other fungus recorded was *Placosphaeria junci* Bubák which was already known to occur in Wales (Grove, *Br. Coelomycetes,* **1,** pp.242-3).

Turf

Most of the information on incidence in this section has been gleaned from the Journal of the Sports Turf Research Institute 1957 to 1961 Vols. 9 and 10), in particular from the Turf Disease Notes (1957, J. Drew Smith; 1958 to 61 inclusive, N. Jackson). In 1959, *Fungal Diseases of Turf Grasses* by Drew Smith was published by the Institute (a second edition appeared in 1965). The same author also gave an account of turf diseases in the north

of Scotland (*J. Sports Turf Res. Inst.* 1959, **10,** 42-6) and studied the effect of species and varieties of grasses on turf diseases (ibid. 1958, **9,** 462-6).

All literature references given below relate to the Journal of the Sports Turf Research Institute, Bingley, Yorkshire unless otherwise stated.

The normal seasonal decline in **Fusarium Patch Disease** (*Calonectria nivalis* Schaffnit) during the summer was not in evidence in 1958—a notably wet year. Most outbreaks recorded in 1959 were in early spring or late autumn: except where watering was heavy, very little was seen during the dry summer months, but outbreaks were often severe in the late, wetter, months of the year. A cold and dry spring restricted its development in 1960, and serious attacks were few until the onset of winter. In 1961, few of the early attacks were serious as spring growth of grass was very slow and late, but examples were confirmed by S.T.R.I., Bingley in every month from July onwards. Trials with various fungicides are reported in the Institute's Bulletins for 1957-61: Drew Smith also experimented with griseofulvin (*Ann. appl. Biol.* 1957, **45,** 206-8; see also *J. Sports Turf Res. Inst.* 1956, **9,** 203-9) and examined the effect of lime on the occurrence of the disease on a forced *Poa annua* turf (1958, **9,** 467-70).

There were many serious outbreaks of **Ophiobolus Patch Disease** (*Ophiobolus graminis* (Sacc.) Sacc. var. *avenae* E. M. Turner) in the late summer and autumn of 1958. The S.T.R.I. (N. Jackson) reported that in most cases the occurrence could be related to applications of calcareous materials which raised or maintained the pH of the turf. In all specimens examined at Bingley, *O. graminis* var. *avenae* was the causal agent, and no *O. graminis* was encountered. Outbreaks in 1959 were much fewer and less serious than in 1958 and occurred mainly in early spring and late autumn, while 1960 brought few outbreaks until autumn when attacks were numerous and serious in many parts of Britain, the patches continuing to be active late in the year in the favourable weather conditions. In 1961, infected samples recorded at Bingley increased from July onwards and various parts of the country had severe attacks in late summer. Jackson reported on a fungicide trial (1958, **9,** 459-61).

Following heavy attacks of **Dollar Spot** (*Sclerotinia homoeocarpa* F. T. Bennett) in 1956, thin areas were apparent in spring 1957 in fescue sea-marsh turf in bowling greens. The disease was very little in evidence in 1958, and in spring 1959, but became active in late autumn 1959 with small-spot symptoms persisting throughout the winter, the fungus again resuming activity in spring 1960. Most cases of dollar spot in 1961 came in mid-summer and it gradually decreased in significance till the end of the year. Drew Smith investigated various fungicides (1957, **9,** 353-9) including cadmium chloride/urea and reported on experiments with griseofulvin (*Ann. appl. Biol.* 1957, **45,** 206-8; see also S.T.R.I. Report for 1956, pp. 203-9). He also studied the effects of this disease on the botanical composition of sea-marsh fescue (1957, **9,** 322-3).

Judging by the particular prevalence in 1958, all over the country, of **Red Thread** (*Corticium fuciforme* (Berk.) Wakef.) it found the wet conditions favourable. The dry early months of 1960 brought few cases but the wet conditions from July onwards resulted in many outbreaks. Mild weather allowed this disease to persist late into the winter so that active cases were still being recorded in March 1961. Any types of turf low in

vigour were commonly affected in 1961 from July, and the disease continued until checked by frosts in November. Only the odd records were made in 1957 and 1959. Trials with fungicides were made by Drew Smith (1957, **9,** 367-8) and Jackson, (1960, **10,** 173-4).

Drew Smith (1957, **9,** 324-53) discussed the very many species of fungi which can cause **Fairy Rings,** giving particular attention to *Marasmius oreades* (Fr.) Fr., the most frequent cause of the severe type of fairy rings in British sports turf. Rings due to *M. oreades* were commonly noted during the dry summer of 1959, though fruiting bodies were largely lacking until autumn: bare zones due to this fungus were not prevalent in 1958 though fruiting bodies became quite common and were so again in 1960. Rings attributable to *Lycoperdon* species were frequent in 1958 and fruiting bodies quite plentiful. In 1960, the stimulated green rings, darker than those due to *M. oreades* and mostly caused by *Lycoperdon* spp., *Scleroderma* spp. and occasionally *Psalliota campestris,* were frequently reported.

Caps in abundance were produced by non-ringforming fungi on the experimental ground at Bingley, and elsewhere, in 1960: species of *Psilocybe, Hygrophorus* and *Entoloma* were particularly common.

Drew Smith (1955, **9,** 74) has earlier recorded an unnamed basidiomycete causing small superficial rings of 3 to 12 in. diameter in the surface of turf. In 1959, further examples were received at Bingley from three bowling greens in southern England but, although the effect was unsightly, little damage was done.

During 1959, infection of *Poa annua* by *Colletotrichum graminicola* (Ces.) Wilson was noted in a number of instances. A few records of the fungus on this host, and one on *Agrostis tenuis,* had been made in 1957. Other diseases of turf recorded by S.T.R.I. or by N.A.A.S. advisers, during these years were **Leaf Spot** (*Drechslera siccans* (Drechsl.) Shoemaker) of ryegrass; *Helminthosporium* sp. associated with foot rot, leaf spot and ultimate death of plants of crested dogstail (*Cynosurus cristatus*) at the experimental ground at Bingley (1959, **10,** 51); **Twist** (*Dilophospora alopecuri* (Fr.) Fr.) on *Agrostis;* **Damping-off** (*Cladochytrium caespitis* Griff. & Maubl.); **Damping-off** (*Pythium* sp.); **Brown Patch** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.); **Earth Star** (*Geaster* spp.) from a bowling green in Worcs; the alga *Nostoc;* and the lichen *Peltigera canina.* Trials with seed dressings against *Fusarium culmorum* (W. G. Smith) Sacc., which is responsible for post-emergence seedling troubles, were made by Drew Smith (1957, **9,** 369-72) and Jackson (1958, **9,** 455-8). Jackson also observed the effect of fertilizers, fungicides and height of mowing on the incidence of 'melting out' disease of *Poa pratensis* turf caused by *Drechslera vagans* (Drechsl.) Shoemaker (1959, **10,** 51-2).

Diseases of Vegetables and Herbs

The fifth edition of L. Ogilvie's *Diseases of Vegetables** (*Bull. Minist. Agric. Fish. Fd*, No. 123) was published in 1961.

Artichoke

The sole attack reported on Jerusalem artichoke (*Helianthus tuberosus*) was of collapse of scattered plants in a crop in Cornwall due to **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary).

A fungus agreeing with descriptions of *Ramularia cynarae* Sacc., which causes **Leaf Spot** in several European and other countries, was prevalent, especially on the older leaves, of most globe artichoke (*Cynara scolymus*) plants in a one-acre crop at E. Wittering, Sussex in September 1958. *R. cynarae* had not previously been seen in this country.

Asparagus

Violet Root Rot (*Helicobasidium purpureum* Pat.) was again noticeable in patches in a few crops in the Worcs growing area and gave trouble in three crops in Kent and Glos. Known to be only sporadic in its appearances, **Rust** (*Puccinia asparagi* DC.) failed to attract any attention, in fact the outbreak in 1956 in Lancs is the only one to be reported since 1942. *Zopfia rhizophila* Rabenh. was associated with **Root Rot** in a Kent crop. The significance of this fungus as a root rotting agent was still not clear. A *Fusarium* of the *F. oxysporum* type caused great loss from an asparagus crop in Suffolk in 1959.

Aubergine

About half of a small crop in a glasshouse in Worcs was lost because of **Botrytis Rot** (*Botrytis* sp.) of the fruit in 1959.

Beetroot

Downy Mildew (*Peronospora farinosa* (Fr.) Fr. f. *betae* Byford) was seen in the Eastern Region but was mainly slight. A few severe losses were brought about by **Dry Rot** (*Pleospora björlingii* Byford) e.g. 70-80 per cent of a 20-acre crop was lost in clamp in Dorset. This latter fungus and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. were variously responsible for outbreaks of **Black Leg.**. Also reported during these years were **Rust** (*Uromcyes betae* Kickx), **Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) including the knob-like form, **Clamp Rot** (*Botrytis cinerea* Fr.) and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn).

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* Now in 6th edition (1969).

Silvering (*Corynebacterium betae* Keyworth, Howell & Dowson), which is most prevalent in crops of cv. Cheltenham Green Top, was reported by advisers from Essex and Lancs. According to *Rep. natn. Veg. Res. Stn, 1959* (p. 40) severe outbreaks were recorded on some commercial holdings that year. Proof of the pathogenicity of the organism had been demonstrated just prior to this five-year period (Keyworth *et al.*, *Pl. Path.* 1956, **5,** 88-90). Observations and experiments on the disease at N.V.R.S. from 1952-59, were reported by Keyworth and Howell (*Ann. appl. Biol.* 1961, **49,** 173-94). These workers found that streptomycin and erythromycin gave almost complete control.

Beet Mosaic virus was widespread in seed plants in one district of Essex in 1960 but, apart from a few reports from the south-east that year, this disease drew no other comment. Other diseases of which only the odd report was received were **Virus Yellows** (p. 49), **Heart Rot** (boron deficiency), **Manganese deficiency,** and **Strangles** and **Black Leg** both attributed to non-parasitic causes.

Symptoms similar to clayburn in carrots (see Moore, *Bull. Minist. Agric. Fish.* No. 126, 1944, p. 44) were seen in three crops of cv. Cheltenham Green Top type in 1958 in Kent and in two beetroot crops in Surrey in 1959. Depressed, black, necrotic lesions were conspicuous on the roots. The trouble was thought to be non-parasitic in origin. On one of the Surrey farms, clayburn in carrots had been found in the past.

Brassicae

Diseases of kale and rape, and turnip and swede are discussed on pp. 53-57.

Each year the customary high number of records of **Club Root** (*Plasmodiophora brassicae* Woron.) on brassica crops came from all parts of the country. Outbreaks were particularly severe in 1957, incidence being above average in several areas. Attacks were above normal in Wales and the extreme south-west in 1958, and at the end of 1959 many crops in Anglesey and Caerns had extensive infection sometimes reaching 100 per cent. Club root had recently been causing concern in mid-Wales where it appeared to be on the increase and very serious especially in Carms. In years when club root was less troublesome, severe attacks were sometimes reported on irrigated crops. A monograph on the disease by Colhoun appeared as *Phytopathological Paper No.* 3 (1958) of the C.M.I. Taylor and Morgan (*Pl. Path.* 1958, **7,** 61-3) published the results of a 1956 survey in Wales. Colhoun described a technique for examining soil for the presence of the organism (*Ann. appl. Biol.* 1957, **45,** 559-65) and Gwynne (*Ann. appl. Biol.* 1959, **47,** 361-3) attempted to assess soils in selected fields in N. Wales for the presence of *P. brassicae* in 1957. Colhoun (*Trans. Br. mycol. Soc.* 1961, **44,** 593-600) studied factors influencing incidence: he found the relationship between spore load and the number of plants developing club root to be markedly affected by light intensity and discussed the bearing of his results on the use of a pot test for evaluation of spore loads in soils. *The Research and Experimental Records of the Ministry of Agriculture, Northern Ireland,* have reported during these years on control measures, the examination of soil for the presence of the organism and the relation of plant nutrition to incidence of the disease. Macfarlane used a

solution-culture technique for obtaining root-hair, or primary, infection (*J. gen. Microbiol.* 1958, **18,** 720-32) and Macfarlane and Last (*Ann. Bot., Lond.* N.S. 1959, **23,** 547-70) studied the effect of infection on the growth of young cabbage plants.

Rosser (*Pl. Path.* 1957, **6,** 42-4) compared various alternative fungicides, including quintozene, with mercuric chloride for control of club root on cabbage and made further trials using chloronitrobenzene dusts applied to the soil before planting or in the dibble holes (*Pl. Path.* 1959, **8,** 13-5). Norman *et al.* (*Ann. appl. Biol.* 1959, **47,** 364-6) compared quintozene and tecnazene with mercuric chloride for control; and Channon and Keyworth (*Ann. appl. Biol.* 1960, **48,** 1-7) in field experiments from 1956-8 on the effects of soil applications of aldrin for control on summer cabbage obtained a reduction in clubbing but also some phytotoxic effects at the higher doses. Channon reported further trials (*Rep. natn. Veg. Res. Stn, 1959,* 41-2 and *1960,* 48). Wiggell *et al.* (*Ann. appl. Biol.* 1961, **49,** 110-9) experimented with various fungicides and obtained good results with pure (100 per cent) calomel: this treatment was proving very successful and popular with growers. Croxall briefly reviewed current knowledge of the disease (*N.A.A.S. q. Rev.* 1959, **11,** 20-24).

Numbers of outbreaks of **Canker** (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) were investigated each year, many of them severe. In many Flat Poll cabbage crops in Devon and Cornwall in 1958, affected plants were noted when pulled in the seed bed or at planting time; these often had internal brown necrosis. Up to 25 per cent was affected in two of the outbreaks. The Brussels sprout cultivar Irish Elegance was noted to be particularly susceptible in several Regions in 1961. In most years, **Ring Spot** (*Mycosphaerella brassicicola* (Duby) Oudem.) was rarely severe except in Wales and the extreme south-west. In 1957 it was above average in S. Wales, also in Devon and Cornwall with severe defoliation in many crops; and in 1958 it was more severe than for some years in the South-eastern Region. Wales and the south-west continued to be the main source of records each year but ring spot was particularly common in mid-Wales in the last two years. Brussels sprouts, broccoli and cabbage were the main brassicas affected. Dring (*Trans. Br. mycol. Soc.* 1961, **44,** 253-64) discussed the nomenclature, morphology and life history of the fungus and concluded that the *Phyllosticta* stage (*P. brassicicola* McAlpine) is wholly spermatial in function. Observation studies on the resistance of cultivars to ring spot were being made at the N.A.A.S. experimental station at Rosewarne. **Powdery Mildew** (*Erysiphe cruciferarum* Junell) was unusually prevalent in the Evesham Area in summer 1957, particularly on Brussels sprouts. Moderate general attacks were reported from Beds late in 1959 on winter cabbage and Brussels sprouts. Most crops in Hunts and Beds were affected to varying degrees in 1961, and there was much concern. In one attack in Worcs mildewed plants were killed by frost—while those unaffected continued to grow and crop. Tomlinson and Webb controlled mildew on cabbages in pots in glasshouse experiments with zinc fritted glass (zinc frit) or solutions of zinc sulphate (*Nature, Lond.* 1958, **181,** 1352-3).

Reports of **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) came as usual from all parts of the country and this common disease was some-

times severe in seed beds particularly in 1958 and 1960. Hearts in cabbage crops were sometimes affected by **Grey Mould** (*Botrytis cinerea* Fr.), trouble often being associated with a high nitrogen status of the soil. Brussels sprouts were also affected. Except in Anglesey, where it is noted almost every year, **White Blister** (*Albugo candida* (Hook.) O. Kuntze) was noticed only in 1957 and 1961. In 1957 it occurred in a few widely scattered parts of the country: in a 40-acre Kent crop, infection was severe on all Brussels sprouts and on about 15 per cent of the broccoli. On another farm over half of a batch of 600 summer cabbages was affected. The fungus was observed in a few places in 1961, but in September infection was said to be more severe than ever before on Brussels sprouts at the Efford experimental station, while adjacent cauliflowers were unaffected. It appeared to be above average in 1961 in Anglesey. Bad scorching (50 per cent in parts), caused by **Light Leaf Spot** (*Gloeosporium concentricum* (Fr.) Berk. & Br.) occurred on five broccoli cultivars on a Dorset farm in 1958, but its effect may have been accentuated by frost. In 1957, severe infections were seen in Pemb in broccoli and the disease was prevalent, though slight, in spring cabbage crops in Carms in May. In 1958 there was more than usual on broccoli in S. Wales; while attacks were of medium intensity and general in Brussels sprouts in Beds in 1958. In the Gower region of Glam it was present on the older leaves of many broccoli crops in 1959. A few other widely scattered records were received during 1957-9 but none after: hardly any mention was made of this disease in reports from the north. **Dark Leaf Spot** (*Alternaria brassicicola* (Schw.) Wiltshire) was reported infrequently but is likely to have been present in many brassica crops if not causing trouble. It was reported on several occasions in the extreme south-west causing fairly severe damage in 1960. In some cases it caused damping-off in seed beds. Seed crops of various brassicas were infected, one or two heavily. In 1961, losses were heavy in a cabbage seed crop in Cornwall and spotting of cauliflower curds was noted on a Devon farm. *A. brassicae* (Berk.) Sacc. was mentioned in only one report (Norfolk). There were many attacks of **Wire Stem** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) in the Yorks and Lancs Region in 1957 and 1958: in 1961 it was above normal there. Elsewhere, attacks were occasional but sometimes extensive and heavy in seedlings. In 1960, outbreaks were heavy locally in Holland (Lincs) on cauliflowers and more frequent than usual on pot cauliflowers in the Evesham Area. Several instances of damping-off, some bad, occurred in cabbage seedlings in Devon and Cornwall the same year and wire stem was common in Cornish broccoli beds and sometimes severe. Keyworth (*Trans. Br. mycol. Soc.* 1959, **42**, 398) showed quintozene to be highly effective in trials against wire stem of seedlings. *Phytophthora* and *Pythium* spp. and *Corticium solani* were responsible for a number of outbreaks of **Damping-off**, and **Foot or Root Rot** but only a few heavy losses were reported. *Phytophthora* spp. were the main cause of trouble, usually on waterlogged soils, and in several instances *Phytophthora megasperma* Drechsl. was involved. Several foot and root rot attacks due to species of *Phytophthora* were noted in Devon during 1961 in Brussels sprouts and savoys. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) caused a soft rot of Brussels sprout stems in a Sussex field in 1958.

Isaac (*Ann. appl. Biol.* 1957, **45**, 276-83) described a wilt of Brussels sprouts, due to *Verticillium dahliae* Kleb., which had not previously been recorded in this country. **Verticillium Wilt** had first been noted in 1953 near Evesham and appeared to be more widespread in that area than had been realized. The fungus appeared to be a distinct pathological strain and its effects were found to be more severe in wet than in dry seasons. In August 1958, symptoms were prevalent on Brussels sprouts throughout the Vale of Evesham and *V. dahliae* was confirmed in several outbreaks. In 1960 the fungus was isolated from stems of this crop from several holdings in Worcs and was confirmed in two Worcs crops in 1961 and was apparently severe.

An interesting record in Flints in 1960 was the occurrence of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) on a Brussels sprout plant which had blown over. Symptoms of **Leafy Gall** (*Corynebacterium fascians* (Tilf.) Dowson) were present on cabbage plants in Evesham. **Bacterial Spot** (*Pseudomonas maculicola* (McCull.) Stev.) was seen a few times in cauliflowers. Browning of cauliflower curds associated with a species of *Pseudomonas* occurred in a crop in the South-western Region and may have been connected with water settling around the flower stalk. Outbreaks of **Black Rot** (*Xanthomonas campestris* (Pammel) Dowson) were confined to the Wye and Starcross Sub-Regions, though this disease may have been more common than would appear. There were confirmed outbreaks in the former area in most years. In 1958, black rot was well above average in brassica crops in Devon and Cornwall. **Bacterial Soft Rots** were above normal in cauliflower curds in Lancs in 1957 and a soft slimy rotting of the 'buttons' in Brussels sprout crops was fairly general by autumn 1958 through the Vale of Evesham. Soft rots following powdery mildew were quite severe in cv. January King cabbages in W. Norfolk in 1959. Broccoli curds were affected in a few areas, particularly in the Yorks and Lancs Region where soft rot was frequent in the summer of 1961 and in W. Cornwall in 1960 where the trouble was often serious.

Cauliflower Mosaic virus was in general only locally troublesome each year except in 1960. Early that year attacks on broccoli were frequent in the Yorks and Lancs Region but not very damaging, and in Devon and Cornwall where some considerable losses were experienced. In late autumn 1959, the proportion of winter cauliflowers with symptoms of the virus in the main growing areas of N. and E. Kent was low but, following heavy vector infestations at that time, far higher incidences appeared in crops by maturity in the late winter, though generally few plants were spoilt as infection was late. Symptoms on spring cabbage in Worcs were more prevalent and severe than usual in April 1960 and symptoms were severe in one or two parts of the Eastern Region. In late summer and autumn, attacks had become widespread in the Midlands and in much of the Eastern Region, and were above average in the South-eastern Region. Many of these attacks were severe; in parts of Holland (Lincs) the whole crop was attacked and instances of 50 per cent infection were quite common. In 1961 mosaic was more particularly noticeable in the west Midlands, Beds and Devon. **Cabbage Black Ring Spot** (strain of turnip mosaic virus) was noted on broccoli or cauliflower crops a few times only in reports,

but was said to be prevalent in the Lee Valley in 1960. In some plots in Ches, symptoms appeared in 1960 on plants of cabbage, kale, kohl rabi, broccoli, cauliflower and 'wild cabbage'. Broadbent (*Ann. appl. Biol.* 1960, **48,** 377-83) has studied the infectivity of aphids fed on plants infected with the above two viruses.

Following a low level of infection at survey sites in Northumb and Dur in 1956-57, **Turnip Yellow Mosaic** virus was moderately severe in 70 per cent of a cauliflower crop in Dur in August 1957 and was seen on four other occasions in the Northern Region and once in Pemb. This virus had first become widespread in commercial brassica crops in part of Northumb in 1952 and had originally been attributed to the turnip yellow mosaic of Markham and Smith, TYM(E), but Broadbent and Heathcote (*Ann. appl. Biol.* 1958, **46,** 585-92) showed the latter to be serologically related to, but differing antigenically from the Northumberland virus (TYM (N)). Croxall *et al.* gave the results of a survey of the virus in broccoli in the north-east from 1953-57 (*Pl. Path.* 1959, **8,** 99-107), which revealed the benefits obtained by the gradual adoption of control measures such as isolation of seed beds, and seed treatment and spraying with insecticides. Croxall also gave a general account of the disease (*Expl Hort.* 1961, No. 4, 77-9).

A comprehensive review of the research work on the virus diseases of brassicas was compiled by Broadbent and published by the Agricultural Research Council as *Report Series* No. 14, 1957, '*Investigation of Virus Diseases of Brassica Crops*': Cambridge University Press. Kavanagh reported on the first detailed studies on virus diseases of crucifers in Ireland (*J. Dep. Agric. Eire,* 1957-8, **54,** 157-8).

Whiptail (molybdenum deficiency) appeared in some crops, and was reported to be severe locally in Beds in 1959. Wright (*Rep. natn. Veg. Res. Stn, 1957,* 46-7) described a combined treatment for the control of cabbage root fly and whiptail in summer cauliflowers which included sodium molybdate in the insecticide solution. Brussels sprout crops in Beds were reported in several seasons to be affected by **Boron Deficiency**: in 1959 it was heavy generally there. Stem splitting in several crops in Dorset in 1958 was thought to be due to adverse weather conditions and boron deficiency. Boron deficiency, often followed by bacterial soft rots, was common in the Starcross Sub-Region in 1961 and was thought to be probably associated with the traditional practice of liming before the brassica crop. **Blindness** of cauliflowers was heavy in a few stocks in Holland (Lincs) in 1959, and reported occasionally in some areas in 1959 and 1960. Mounsey-Wood (*J. hort. Sci.* 1957, **32,** 65-73) found blindness to be influenced to some extent by sowing date and that frost periods particularly in the late autumn affected the subsequent amount of blindness. Her further experiments (*Expl Hort.* 1961, No. 5, 13-8) indicated that day-length during germination plays an important part in the effect of sowing date on blindness. Salter confirmed that the effect of low temperatures during certain stages of seedling development was to cause blindness (*Nature, Lond.* 1957, **180,** 1056). Jenkinson and Campbell wrote (*Pl. Path.* 1957, **6,** 92-4) on a condition of winter cauliflowers known as **Scorch** which has caused considerable crop losses in the south-west, where it has been known for many years.

Internal Browning of Brussels sprouts caused increasing concern,

and investigations into the cause of this disorder continued at the National Vegetable Research Station (see annual reports).

Among other troubles reported on brassicas, purpling of cauliflower curds was said to be widespread though not severe in Worcs in 1958, and curd breakdown was general and severe in the Evesham area in June 1957 with up to 60 per cent losses reported. The breakdown was thought to be associated with prolonged drought and high temperature and was also prevalent in June 1958 in Worcs. A considerable amount of 'ricy curd' and discoloration of cauliflower curds was reported from Glos in May 1959; and there were a few instances of curd browning in the Eastern Region in 1961 and in Worcs during the summer 1959 and in 1961, occasionally causing severe loss of marketable heads. There was considerable loss of plants in heavy soils in Herts in the wet 1958 season due to **Waterlogging** and other instances elsewhere. In Kent, Veitches Self Protecting cauliflowers examined from a single patch of 10 yd diameter in a 3-acre crop showed scorching of leaves, and stem cracking, with a ladder-like effect in the pith. The worst affected plants had softening of stems just above soil level. The trouble was first noted the day after a severe thunderstorm and may have been **Lightning Injury.** The non-parasitic **Oedema,** giving blackened areas on Brussels sprouts, was widespread in autumn 1958 in the east Midlands. Several reports of damage by drifted hormone weedkillers were received.

Carrot

The first appearance in this country of **Alternaria Leaf Blight** (*Alternaria porri* (Ell.) Ciferri f. *dauci* (Kühn) Neerg. syn. *A. dauci* (Kühn) Groves & Skolko) in 1958 was one of those instances where a disease not previously recorded here, independently appears in several localities at roughly the same time. During the late summer and autumn this disease infected carrot crops in three places in Norfolk, and one each in Cambs, Lincs and Notts. Crops were severely and sometimes extensively attacked, but as previously reported abroad, the fungus was confined to the older outer leaves which were often prematurely killed while the inner leaves remained green and healthy. These sudden appearances could not be related to any particular factors but perhaps the high rainfall and humidities of that year may have encouraged it. From 1958 to 1961 there were no further outbreaks, but Hewett (*Agriculture, Lond.* 1964, **71,** 555-6) was able to find the fungus commonly in seed samples tested in 1961. A report on the field outbreaks was given by Hawkins *et al.* (*Pl. Path.* 1959, **8,** 76).

Not recorded in England and Wales on this host until recently (see p. 236), **Licorice Rot** (*Centrospora acerina* (Hartig) Newhall) was found attacking carrots in a market garden in Edinburgh in the spring of 1957. This was the first time it had been found in Great Britain and Srivastava recorded the outbreak in *Pl. Path.* 1957, **6,** 113. The same author also reported on his studies on the fungus (*Trans. Br. mycol. Soc.* 1958, **41,** 223-6). Two instances of blackening of the surface of pre-packed carrots by *Chalaropsis thielavioides* Peyron. occurred in I. of Ely in 1957, apparently following severe washing: another attack after washing occurred in 1960. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. in the *Rhizoctonia* stage was found on dying leaves, petiole lesions and on leaf bases of a crop in I. of Ely in September 1958.

Appearing first in patches, the trouble spread later to neighbouring plants. The fungus was present in abundance on moribund leaves and browned petiole bases of a crop in Norfolk where alternaria leaf blight was present also. On roots, *Rhizoctonia* was frequently associated with surface lesions or discolorations which gave rise to many complaints in the Yorks and Lancs Region in 1960, and also caused bad rotting of roots in a Norfolk clamp in spring 1960. **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was noted once or twice in most years, and was said to be quite severe in one Norfolk area in 1960 and present in many fields there in the previous year. A severe attack on a crop on light soil in the South-eastern Region was noticed to be much worse under irrigation than on that part of the field without irrigation. In September 1959, infection by **Powdery Mildew** (*Oidium* sp.) in two fields at Warboys, Hunts was such that both crops appeared white from a distance, the leaves being covered with mycelium and spores. No perithecial stage could be found. A similar attack occurred the same month in Jersey and, shortly after, crops throughout the island were affected. There seemed to be little effect on the crop, but sizeable roots would already have been formed before the attack was established. The Hunts attack proved to be the first report of a powdery mildew on carrots in Great Britain but there are records of *Erysiphe* spp. on carrots abroad and the present author has seen powdery mildew on carrot seeds from merchants' stocks in this country. It was thought that the *Oidium* seen in the field on these occasions may belong to *Erysiphe polygoni*. The outbreaks were described by Hawkins and Phillips in *Pl.Path.* 1960, **9.** 113-4. Attacks of **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were heavy locally in the Holland area of Lincs at the end of 1959, and the fungus was abundant in a store in Salop in 1960 after damage at lifting. **Black Rot** (*Stemphylium radicinum* (Meier, Drechsl. & Eddy) Neerg.) affected much of a second-year crop grown for seed in Surrey in 1960, the blackening being seen above ground, and was noted in Norfolk in 1961. Hewett (*Agriculture, Lond.* 1964, **71,** 555-6) noted this fungus commonly in carrot seed examined in 1961. **Common Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) had not often been confirmed on carrots in the field in this country although Jones produced typical raised lesions experimentally by inoculating carrots with different strains of the organism (*Nature, Lond.* 1953, **171,** 574). Lesions, typical of what might be expected from scab infection, were present on carrots in N. Yorks early in 1960, and pre-packing stations were throwing out 5-10 per cent of the roots sent in by growers because of this condition. Similar lesions were seen on a crop in Lincs. Small amounts of **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) were reported in E. Suffolk in over-wintered carrots in 1959 following severe January frosts.

A virus disease, thought to be probably the same as described from Australia by Stubbs as **Carrot Motley Dwarf** had been identified by 1960 from seven counties by Watson (*Pl. Path.* 1960, **9,** 133-4). Watson and Serjeant (*Rep. Rothamsted exp. Stn, 1961,* 106-7) showed that the disease was caused by simultaneous infection by two viruses, red leaf and carrot motley dwarf (mottle). It was first seen on a farm near Newmarket in 1956 and until then had not been identified in Great Britain. It was very prevalent in 1959 and is important economically in some seasons. It causes stunting, a yellow and green mottle of the foliage and bending and twisting of the

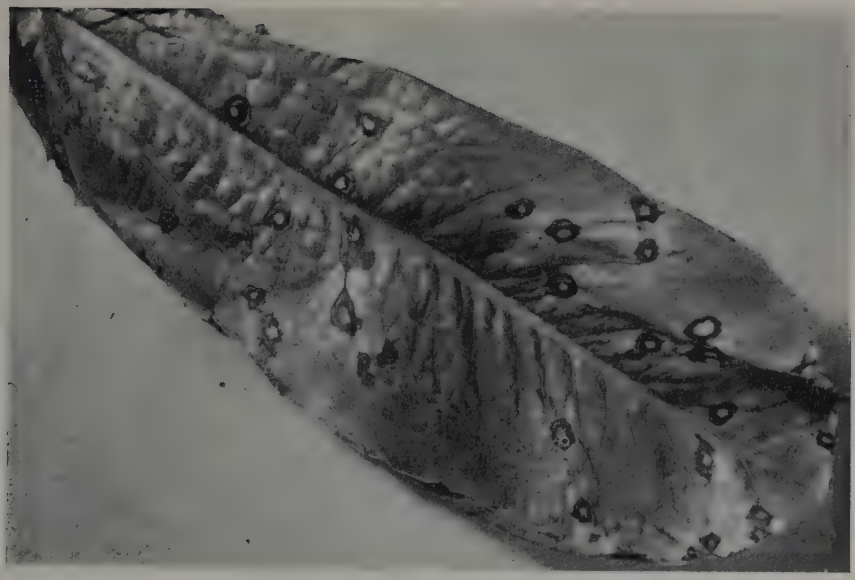
older petioles. Symptoms were noted in a Surrey crop in 1960. In 1961, carrot crops generally were badly crippled by motley dwarf: in the South-eastern Region some were ploughed in. The disease appeared extensively in crops sown early but the later sown ones were much less affected. Symptoms were seen throughout the 150 cultivars in a trial at Efford, Hants: there appeared to be a marked difference in the response of the cultivars to infection independent of sowing date. In the same year the disease was recognised for the first time in the Yorks and Lancs Region where it appeared in all carrot growing areas in July on 'Chantenay' types, being frequent and sometimes severe. Other affected crops were noted in Surrey and the Evesham Area.

A disease similar to **'Pit'** (or **'Ringy'** or **'Watermark'**) (see Moore, *Bull. Minist. Agric. Fish.* 1944, No. 126, p. 44) caused considerable trouble in the East Midland Region in 1960, and was widespread in the main carrot-growing areas. It was first noticed at lifting. A similar unexplained trouble called 'cavity spot' was described by Guba *et al.* (*Pl. Dis. Reptr*, 1961, **45**, 102-5). Symptoms in two crops grown on bunter sand in Notts appeared in the early stages as small discoloured oval depressions with narrow, darker margins, and elongated at right angles to the main axis of the tap root. The lesions usually occurred at the point of attachment to the lateral roots, and deepened though the epidermis remained intact: in washed roots the epidermis tended to be rubbed off leaving a clean pit. Sometimes many pits had coalesced to form large lesions. Red-cored cultivars were generally susceptible but the yellow-cored much more resistant. Probably the disease is a physiological one. Similar symptoms were reported in 1960 in single crops in Hants and Berks, and in 1961 in Norfolk and Surrey. In the latter crop, which was extensively affected, a species of *Pythium* was found in the affected tissues (see Moore, *Br. Parasitic Fungi*, p. 321). However, in 1961, little trouble was experienced in the east Midlands.

Some consignments from Norfolk were rejected at the cannery in 1957 because of **Clayburn** (non-parasitic). According to an article in the *Commercial Grower* (A. W. Punter and M. Holden, 27 February 1959) this trouble had come into particular prominence in the previous three years: the authors pointed out that carrot growing had extended from the really light sands to the slightly clay sands and crops on these latter can give rise to the complaint. Various blemishes during processing caused rejection of consignments grown for canning in the Eastern Region in 1960 and gave further trouble in 1961; the troubles, the most common of which is known as **'Five O'Clock Shadow'**, and which was under investigation, seemed to be associated with particular fields. In 1961, horticultural officers in Norfolk reported various disorders including hollowness, silvering in the core, and production of many stringy side roots from the core. The disorders were thought to have resulted from poor growing conditions and checks, followed by rapid growth later in the autumn. Samples showed narrow black concentric broken rings about 8 in. from the surface, thought to be associated with the commencement of bolting.

Celery

Leaf Spot (*Septoria apiicola* Speg. formerly distinguished as two species,



1. Leaf spot (*Pleospora herbarum*) on a lettuce leaf (p. 93).

2. Watercress root showing symptoms of crook root (*Spongospora subterranea* f. *nasturtii*) (pp. 112, 252).

PLATE III

Tomato roots affected by the potato powdery scab fungus, *Spongospora subterranea* f. *subterranea* (p. 106).

PLATE IV

S. apii-graveolentis Dorogin and the less common *S. apii* Chester) had become much reduced with the wider practice of hot-water treatment of the seed. In the Lancs growing areas and the east Midlands a few crops were affected in 1957 and 1958 but little was seen in the later years. There were some heavy attacks in a few Eastern Region counties in 1957 and leaf spot developed late in many counties of the Region in 1958 and was fairly widespread and often severe, It was seen in celery crops elsewhere in the country but incidence was mainly low, and in the last two years very little was seen anywhere. By 1961 it was estimated in I. of Ely that more than 95 per cent of crops were being raised from hot-water treated seed. The continued importance of seed as a source of infection was stressed by Marshall (*Ann. appl. Biol.* 1960, **48,** 27-33) who found that of all the celery samples tested at the O.S.T.S., Cambridge in 1957-8, 78·8 per cent had some infection with *Septoria.* Of the samples submitted specifically for a test for *Septoria,* those with less than 1 per cent infection had increased from 6·1 per cent in 1926-31 to 46·2 per cent in 1953-8 and the percentage of heavily infected samples had decreased. However, seed samples submitted to the station since 1949 for purity and germination tests only were more heavily infected (in 1953-8 only 26·3 per cent had less than 1 per cent infection while, as stated above, in 1957-8 78·8 per cent of all the samples tested showed evidence of infection). These figures showed the need for continued routine treatment, by an effective method, of commercial stocks in this country. The Seeds Regulations of 1961, required that buyers of seed must be told whether or not it is free from leaf spot or whether the seed has been effectively treated against it.

Crater Spot (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was extensive and sometimes severe in some parts of Norfolk every year. It was worse in over-mature plants. It caused worry especially to growers washing and pre-packing celery, and the lack of control measures was very much felt. The disease was particularly troublesome each year along the eastern edge of the Black Fen in East Anglia: it had become the most serious trouble in this important celery district. Some doubts existed as to the cause of crater spot and investigations on the disease were started at the National Vegetable Research Station. One or two attacks were reported from the Lancs growing area.

Violet Root Rot (*Helicobasidium purpureum* Pat.) appeared in the Eastern Region a few times. Attacks of **Root Rot** (*Phoma apiicola* Kleb.) were recorded in most years and it was occasionally severe. In 1957 it was above normal in the Yorks and Lancs Region. In the east Midlands in 1961, low-lying crops were badly affected where irrigation was used and the disease appeared to have been spread by this means. **Root Rots** due to species of *Pythium* occurred occasionally and the fungus caused moderate and general damping-off in I. of Ely in 1960 and severe attacks on some holdings the next season, and was troublesome in a district of Norfolk. *Artotrogus hydnosporus* Mont. syn. *Pythium artotrogus* de Bary causes root rot ('Rusty Root') in celery. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was severe and general on one Norfolk crop and noted on the odd occasion elsewhere. In 1961, oospores very similar to those of an *Olpidium* sp. were found in the roots of self-blanching celery seedlings, patches of which had yellowed-off, on a Glos nursery; the roots had a scorched

look and possibly some toxic factor was also involved. The fungus was confirmed in one case in Norfolk where patches of plants were failing to grow. Many dead roots were present on the affected plants and *Olpidium* sp. was present in quantity in the browned roots. Bacterial **Soft Rots** were above normal in Yorks in 1957; and in 1959 a soft rot of the apical leaves on a Glos farm was associated with dipterous larvae, probably *Scaptomyza graminum*, which had previously been associated with soft rotting in celery. Symptoms of **Cucumber Mosaic** virus were rather common in Lancs in 1959 but otherwise noted a few times only, and there were several reports of variable mosaic-type virus symptoms on celery. Severe symptoms were present on self-blanching cultivars, less on New Dwarf White cultivars, in I. of Ely in 1959 and mosaic-like symptoms appeared to be more prevalent than usual in War and Worcs especially on self-blanching celery. However, in the Evesham Area, in no case was CMV or any other virus isolated by mechanical inoculation. In Glos in 1961, virus infection appeared to be widespread in self-blanching celery and transmission tests in all cases indicated a virus similar to CMV. symptoms included chrome yellow ring marking, yellow spotting with necrotic centres to the spots, and almost complete chlorosis. According to Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 73-4) celery **Yellow Spot** virus was apparently the most common virus in celery crops in 1957 and 1958: he also recorded (*loc. cit.*) celery **Yellow Vein** virus (now considered to be a strain of tomato black ring virus) and celery **Yellow Net** virus.

Black Heart (non-parasitic) only came to notice in 1959 when several attacks were reported from the Eastern Region. In Cambs it was said to be prevalent on cv. New Dwarf White; and in I. of Ely and Norfolk in September was particularly serious on self-blanching cultivars. It was associated with dryness of soil under the roots, as soils with a good moisture content below the roots were quite free from the trouble. By November most crops had grown away from the trouble, although soft rots were developing on some holdings. Black heart was noted also in Lancs and Derby in 1959. **Frost Injury** can do serious damage, as in some Norfolk fields, not finally earthed up, in 1959. **Lightning Injury** was reported once.

Chicory

Canker, often followed by a soft brown rot, affected chicory roots in I. of Ely in 1958 and had been a problem for some years past. Incidence and severity were said to increase progressively where crops were grown for several years in succession on the same land. The cause remained obscure.

Chives

Rust (*Puccinia allii* Rud. syn. *P. porri* Wint.) was seen twice in 1961; in a Salop garden and on most plants in a crop on a Kent herb farm.

Cress

Corticium solani (Prill. & Delacr.) Bourd. & Galz. and *Pythium* sp. caused **Damping-off** occasionally.

Cucumber

In 1958 **Grey Mould** (*Botrytis cinerea* Fr.) was much more common than usual in the Lee Valley; die-back of lateral shoots was seen on a number of nurseries and die-back with stem rotting occurred in many crops. Few other outbreaks were reported. **Blotch** (*Corynespora cassiicola* (Berk. & Curt.) Wei) severely attacked two crops and was noted in two others. **Gummosis** (*Cladosporium cucumerinum* Ell. & Arth.) was severe in some late crops in Essex, Herts and Beds in 1957 and appeared in many crops in the Lee Valley in 1959. In 1958 it was said that in Essex there had been more reports than ever before and the disease was severe in Yorks E.R. in August especially in cv. Butcher's Disease Resister. In Herts in 1958 it appeared earlier than usual and there were several severe attacks though, in general, infection was slight. Hardly any gummosis was seen in 1960 and 1961 and the replacement of Butcher's Disease Resister by the more resistant F1 hybrid cvs. Green Spot and Spottex was thought to be associated. On a Sussex nursery Green Spot exhibited almost, if not quite complete, resistance while other cultivars grown such as Clapham Market and Market Cross were a total loss due to infection. **Anthracnose** (*Colletotrichum lagenarium* (Pass.) Ell. & Halst.) was not reported. An interesting record was that of *Didymella lycopersici* Kleb., found at the graft incision on plants grafted onto marrows in Caerns on a nursery where this fungus had been generally affecting tomatoes badly every year; but infection was mainly due to unhygienic conditions. **Powdery Mildew** (*Sphaerotheca fuliginea* (Fr.) Poll.) attracted little attention in 1957, but in 1958 was noted locally in several areas, being severe in some Middx nurseries in March, and moderate and general in Herts and the South-eastern Region later. Some Lee Valley nurseries had heavy attacks in November 1959 and August 1960, and outbreaks were medium to heavy throughout Middx in 1961. The severity in the Lee Valley in 1961 decreased towards the end of the season and dinocap aerosols were being used successfully. Smith and Read in a series of papers (*Ann. appl. Biol.* 1961, **49**, 102-9, 233-41 and 242-5) gave the results of their investigations on some synthesized fungitoxic derivatives of salicylaldehyde as eradicants of cucumber mildew. The use of vaporized sulphur and other fungicides was also being investigated by these workers at the Glasshouse Crops Research Institute (annual reports *1960*, 84 and *1961*, 81-2). Stone (ibid. *1957*, 123-4) carried on her tests on the resistance of various members of the Cucurbitaceae to cucumber mildew and also the reaction of cucumber plants to inoculation with powdery mildews from hosts such as *Ranunculus repens* and *Sonchus* spp. The perfect stage being rare, the studies (also briefly reported in the 1958 and 1959 reports from the Institute) aimed at finding out if hosts other than cucumber enable overwintering. The identity of the cucumber mildew fungus was not known for certain at this time.

Fusarium Root Rot and **Wilt** (*Fusarium* sp.) gave little trouble. **Stem Rot** (*Mycosphaerella melonis* (Passer.) Chiu & Walk.) was generally above average in the Lee Valley in 1961, but in other years caused little damage until the latter part of each season. Elsewhere the fungus was seen on a few nurseries only: it appeared in N. Wales for the first time in 1961. Most outbreaks of **Damping-off** and **Root, Foot and Stem Rots,** were due to *Pythium* sp. and there were numbers of records each year: *Rhizoc-*

tonia was noted several times and *Phytophthora* spp., e.g., *P. cryptogea* Pethybr. & Laff., occasionally. In 1961 the loss of many plants during the propagating season in the Lee Valley was always associated with considerable browning of the roots. *Pythium* sp. was occasionally isolated from the browned roots but more often only a species of *Olpidium* was found. Loss of plants during propagation had been quite common in past seasons but this was the first time that *Olpidium* had been noted. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was recorded several times in each year. In a large house in Glos in 1961 it was prevalent and severe with infection apparent on the stems at soil level and above, and also on the fruits: in 1960 the complete crop had been lost from the same cause, yet the 1961 crop was grown in fresh soil brought into the house. There was no sign of the perfect stage of the fungus on the nursery. Several attacks of **Verticillium Wilt** (*Verticillium* spp.) appeared every year, a few being severe.

Although its presence had been suspected here for some time, the first authentic record for the country of **Angular Leaf Spot** (*Pseudomonas lachrymans* (Smith & Bryan) Carsner) came in 1957 from Swavesey, Cambs. The bacterium was isolated from frame-grown cucumbers and its identity confirmed in culture and by inoculation by Lelliott (*Pl. Path.* 1958, **7**, 132). There were one or two attacks of bacterial **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye).

Cucumber Mosaic virus was apparent in 1957 and 1960, and in the Lee Valley in 1961, but drew little attention in other years. By April, on a Salop nursery, there was a total loss of crop in 10 houses due to early infection with a virulent strain of the virus. Infection probably occurred in the propagating house and severe symptoms were seen 14 days after planting up. On an Evesham nursery, 33 yd of gherkins were completely infected. Graham (*Virology*, 1957, **3**, 427-8) investigated the cross-protection between strains of tomato aspermy virus and cucumber mosaic virus. **Green Mottle** (cucumber green mottle mosaic virus) affected 40 per cent of the plants in a house in the Lee Valley in 1959, young leaves being mottled and distorted (Plate II). Several crops examined in the Valley and in Essex had symptoms of the virus during 1959 to 1961; some had high amounts, one appearing to be totally affected. Cucumber **Stunt Mottle,** which was first found causing complete destruction of cucumber plants in a dozen glasshouses on a nursery in Ches was shown by Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 71) to be caused by an unusual strain of arabis mosaic virus.

Rotting of the tap root and of some secondary roots, was a fairly common trouble in the Lee Valley and caused losses in most years with high losses on several nurseries. In 1960 many nurseries there were affected and the crops were replanted: on several the main crop had to be pulled out. It was invariably connected with poor bed conditions. *Pythium* is sometimes associated but usually no pathogen could be detected. **Damping-off of fruit** was fairly common in the Lee Valley in April 1958. Superficial white markings on some fruits on nurseries in the area, and adhesion of seed coats, speckling and slight distortion of cotyledons and slow growth in 15-20 per cent of the seedlings under glass on one nursery, were attributed to **Low Temperature Injury.** In a total of several hundred plants, on six Lee Valley nurseries, the main stem suddenly collapsed with toppling:

no disease organism was detected but each soil had a high level of ammonia. The condition showed up simultaneously on several of the nurseries and occurred during a sunny spell after several cloudy and overcast days.

There were a number of reports of various kinds of chemical injury: the use of current-season barley straw bales from a barley crop sprayed with MCPA gave rise to damage of the hormone type to a cucumber crop in the Lee Valley.

Horseradish

A black vascular discoloration developed in some roots from a crop grown for processing in Chester in 1958. The macerated roots normally produce a white viscous fluid, but from this crop the fluid was dicoloured, much reducing its commercial value. No parasitic organism could be isolated from the vessels. Rosser found in a small trial planting of affected thongs, that the discoloration disappeared in 40 per cent of the secondarily thickened roots and these would presumably have processed satisfactorily (*Pl. Path.* 1958, **7**, 75). The laterals produced from affected thongs were completely clear. Clean planting stock in the same trial was unaffected.

Two consignments of roots, similarly affected and of German origin were examined by the present author in 1957. Symptoms varied but most cut roots in T.S. displayed a wide dark brown ring towards the centre, while in L.S. dark streaks extended the length of the roots (Plate V, 2). No pathogen could be detected. Grated roots from one consignment were reported to darken rapidly and develop a foul odour. Symptoms agreed closely with a trouble ('Schwarze') known for many years in Germany, believed to be of non-parasitic origin and possibly connected with soil conditions.

According to Dring (*Trans. Br. mycol. Soc.* 1961, **44**, 333-6), **Pale Spot** (*Ramularia armoraciae* Fuckel) commonly attacks horseradish in Devon and adjoining counties. He described the symptoms, sexual and asexual structures and overwintering sclerotia of the organism and conjectured that the perfect stage of this fungus is possibly a species of *Mycosphaerella;* though if so, it is very rare in south-west England.

Leek

Grey Mould (*Botrytis cinerea* Fr.) caused rotting of flowering stems or leaves on one or two nurseries. There was one attack of **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.); and several of **Foot Rot** (*Fusarium culmorum* (W. G. Smith), Sacc.) notably in 1959 when several extensive losses were experienced in the Evesham Area, practically the whole of half an acre of cv. Yate's Empire being infected in one attack. **Damping-off** by *Fusarium* sp. was severe on early seedlings in frames on one holding. **White Tip** (*Phytophthora porri* Foister) symptoms were widespread in the Vale of Evesham in January 1960 and the disease was confirmed in two crops. Symptoms were again prevalent in November 1960 but examination of specimens from holdings failed to detect *P. porri* except in one case, and excessive wetness was thought to be the basic trouble. White tip was very prevalent in the Gower area of S. Wales in 1959. A few other attacks, one or two severe, were seen in the north and in Som. **Rust** (*Puccinia allii*

Rud.) was believed to be fairly prevalent in Worcs in 1958 and 1960 but was not severe. However, in 1961 it was more severe in the Vale of Evesham than for many years. Few, if any, of the earlier crops were free of infection and, in a lot, disfiguration was caused even after the removal of many leaves: later crops were relatively unaffected presumably as a result of the cold weather. There were a few attacks in other areas during the five years; there were several fairly severe ones in the north in 1957, and in 1958 rust was especially noticeable in the south-west. In one crop in Dur almost all plants were affected.

Damping-off (*Pythium* sp.) was noted once. **White Rot** (*Sclerotium cepivorum* Berk.) appeared once or twice in most years, and **Smut** (*Urocystis cepulae* Frost) was recorded on a few occasions. Mosaic patterns and streaking, were seen on several stocks of plants throughout Northumb and in Lancs: there had been several records of similar virus symptoms on leeks from the north in the past. Up to 5 per cent of the plants cv. Walton Mammoth in 1/3-acre crop in Surrey were stunted with conspicuous chlorosis of leaves and some yellow streaking: there was some evidence of virus transmission to *Chenopodium*. Again in Surrey, half of a 1/3-acre of cv. Best of All was stunted with chlorotic streaking of the leaves which tended to show corrugation: although the symptoms suggested virus infection, there was inconclusive evidence of transmission to *Chenopodium*.

Lettuce

Still the most common disease of lettuces, **Grey Mould** (*Botrytis cinerea* Fr.) was not above average in any of these years except in one or two places locally. It was in general rather more prevalent in the winters of 1957/8 and 1959/60 than in the other seasons. The chloronitrobenzenes, tecnazene and quintozene, had been tested from time to time for the control of grey mould but had the disadvantage that they might check the plants. Brook and Chesters (*Ann. appl. Biol.* 1958, **46,** 159-66) tested three isomers of TCNB against *Botrytis* and found that while they gave some protection, they could check the plants and reduce emergence in treated seed beds. The same authors found that tecnazene smoke generators were promising as a method of control in unheated glasshouses (*Pl. Path.* 1958, **7,** 6-9). Way and Keyworth (*Ann. appl. Biol.* 1958, **47,** 685-97) investigated thiram and captan sprays as alternatives to the chloronitrobenzenes, and demonstrated the value of the former on both field and frame crops, and of captan for seed bed treatment of the field crop. Antibiotics have been tried for controlling *Botrytis*, and Rhodes *et al.* (*Ann. appl. Biol.* 1957, **45,** 215-26) obtained significantly reduced infection with griseofulvin in small-plot trials on summer lettuce. Webb in an article (*Agriculture, Lond.* 1958, **64,** 493-7) on antibiotics in the control of plant diseases, described trials on commercial crops in which infection was considerably reduced with griseofulvin. Hey, Hunnam and Gathercole also reported on the use of griseofulvin (*Grower*, 1957, **47,** 1177-82) on glasshouse crops. The recently introduced dicloran was found to be giving good control of *Botrytis* on lettuce. A low incidence of *Botrytis* was noted by Frost (*Agriculture, Lond.* 1958, **65,** 296-8) when cheap processed paper tubes containing compost were used in transplanting.

Downy Mildew (*Bremia lactucae* Regel) was troublesome in at least some areas each year, and was more prevalent than usual in parts of War, Worcs and the south-west in 1958. In Som it was said to have been a problem throughout 1961. H. J. Wilcox, making a preliminary trial in 1957, found thiram to be the only one of the fungicides he tried, to control mildew without any phytotoxic effect. Zineb and thiram, and mixtures of the two, later became increasingly used. Selection of lettuce seedling progenies for resistance to this disease continued at the National Vegetable Research Station. There were numbers of reports of **Ring Spot** (*Marssonina panattoniana* (Berl.) Magn.) from the east, south-east and south-west of the country. Although not of widespread occurrence in lettuce crops generally, this disease often causes considerable loss when present. It gave little trouble in 1957 and 1958, was severe in a few crops in 1960 but attacked several in 1959 and 1961 and was often very heavy. In 1959 it was more widespread and severe than for some years in Worcs and commoner than usual in the south-west. **Bottom Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) symptoms, as described in 1934 by Townsend in *Mem. Cornell Univ. agric. Exp. Stn*, No. 158 appeared in 1960 on two nurseries in Wilts and Leics respectively (reported by L. Ogilvie, I. F. Storey and I. G. Thorpe). A wet light brown rot of the outermost petioles spread upwards to younger leaves and outwards into the leaf blades. The affected leaves of mature plants developed dark grey slimy areas full of *Rhizoctonia*, and mycelium and sclerotia could be found in the tissues. The attack in Leics, under glass in May, was very severe and about 80 per cent of the plants in two of the houses had bottom rot: the disease was noted again the next year. Somewhat similar symptoms were seen in about 20 per cent of a planting under glass in Suffolk in 1961 and there was severe rotting of the bottom parts of leaves associated with *Rhizoctonia* in a Devon crop, though the fungus was not present in large amounts. In a Lee Valley nursery in February 1959 a large proportion of seedlings in frames bore rusty-brown areas on the leaf tips, especially on the outer leaves: a species of *Itersonilia* was sporing on the affected areas and was isolated in culture.

Leaf Spot (*Pleospora herbarum* (Fr.) Rabenh.) (Plate III, 1) was moderately severe in a crop in 1957 in the south-west and was seen a few times in the later years, some losses being serious in the south-west. **Damping-off** due to *Pythium* was frequent in Yorks and Lancs in 1957 and **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was frequent in Lancs in 1959 and, with *Pythium*, caused considerable damping-off in several nurseries in Essex in 1959. *Pythium*, *Rhizoctonia*, and more rarely *Phytophthora*, occasionally gave damping-off or root rot troubles mainly in the north. In one instance severe damping-off due to *Pythium* followed the use of quintozene to control *Rhizoctonia*.

A **Powdery Mildew** whose conidia and conidiophores resembled *Erysiphe cichoracearum* Mérat was found on old bolted plants in plots of *Bremia*-resistant lines at the National Vegetable Research Station in October 1961 (M. J. Webb, pers. comm.). Thirty-seven of 42 lines were affected and commercial cultivars Borough Wonder and Tom Thumb had very slight infection although All the Year Round and Rudiger were unaffected. No perithecia were seen. Webb also found the mildew on *Lactuca serriola* on a waste plot in Wellesbourne. All plants in the affected plots

were destroyed and no further infection has been seen. This was the first report of the fungus on lettuce in this country though it was known in U.S.A. particularly in California. It was understood to be known in Holland (on *L. serriola* and *Bremia*—resistant lines) and in Switzerland and U.S.S.R.

Bacterial **Soft Rots** were frequent in Lancs in September 1958; and **Marginal Spot** (*Pseudomonas marginalis* (Brown) Stev.) was prevalent in a Caerns crop in 1957, and severe on a holding in Cornwall in 1959. A **Bacterial Wilt,** caused by a species of *Pseudomonas*, in heated glasshouses was investigated by Cleary (*Ann. appl. Biol.* 1959, **47,** 370-2) in both Yorks and Lancs in the winter of 1957/8. The symptoms appeared to be similar to those described by Winifree *et al.* (*Phytopathology*, 1958, **48,** 311-6) in Florida, and associated with a complex of *Erwinia* and *Pseudomonas* spp. This same trouble has since been found a few times in Lancs and Yorks, and was also seen in Staffs in 1961. A similar disease involving a *Pseudomonas* sp. was recorded in Ches in 1959; on some holdings it caused complete loss of crop.

Lettuce Mosaic virus was in evidence annually though little was seen in 1958. In 1957 it was above average in the Northern Region, the Evesham Area and on the eastern side generally: also, in 1960, it was severe in many parts of the country, particularly in overwintered crops. Infection was probably more common than for many years in the west Midlands in the late summer of 1959 and the following winter, attacks being severe and widespread. Several Eastern Region counties experienced heavy attacks in 1961 and there were high levels of infection on many nurseries. Watts and George, and Tomlinson and Smith (*Rep. natn. Veg. Res. Stn, 1957*, 11-12 and 51) tested certain F3 families for their reaction to mosaic and started a search for possible mosaic resistance in wild species of *Lactuca*. The latter workers also studied the importance of seed-borne infection in spread of the disease (ibid. *1959*, 42-3; *1960*, 49). **Cucumber Mosaic** virus appeared in a few crops at the end of 1959: it caused severe losses of over 70 per cent on a holding in Oxon and was extensive throughout a nursery in Herts. In the South-eastern Region the overwintering 1959/60 outdoor crop was most severely affected but CMV was also confirmed in glasshouse crops planted with field-raised seedlings. The unusual season and the high incidence of aphids late that year threatened to lead to a high incidence of this virus in lettuce crops. Ninety per cent of a crop in Derby was very stunted in February 1960 and the presence of the virus was confirmed. Further attacks were recorded in 1960 on winter lettuce in the East Midland Region and there were other heavy attacks notably in the east and south-east of the country. In the Wye Sub-Region plants were described as being very stunted and most leaves had a marked backward rolling and, a few, marginal necrosis. The general appearance was 'spiky' but without marked mottling. While the downward leaf rolling was a diagnostic feature in cvs. May Queen, May Princess and Cobham Green, this symptom was absent in Cannington Forcer. Plants of the latter cultivar were stunted with a marked necrotic vein-banding on both young and intermediate leaves and some marginal necrosis. Several attacks occurred in the Eastern Region early in 1960: infection was quite severe in overwintered cos in Essex with many reports of severe attacks on outdoor crops in Norfolk while, in Suffolk and Lincs, it was locally severe especially on cos crops. The virus was confirmed in a few

crops in scattered parts of the country in 1961: losses were severe in the outdoor growing areas on the mosses of S. Lancs. In 1956, plants of cv. Cobham Green from a Norfolk nursery were found to be infected with a virus disease named **Lettuce Ring Spot** by Smith and Short (*Pl. Path.* 1959, **8,** 54-6). The same virus was confirmed in a batch of plants grown in Cambs. This soil-borne, sap-transmissible, virus is a strain of tomato black ring virus.

It had been suspected for some time that **Big Vein,** as originally described in the U.S.A. by Jagger and Chandler (*Phytopathology*, 1934, **24,** 1253-6) might occur in Britain but the first confirmed outbreak appeared in May 1957 on a crop of cos lettuce in Esher, Surrey (*Pl. Path.* 1958, **7,** 19-22). Tomlinson and Smith also found this disease in three other Surrey crops that year and in seven in Lancs: incidence ranged from 1 to 75 per cent. It was thought to be more widespread than reports had till then indicated and from 1958 to 1961 there were reports each year so that big vein was recorded in all the English Regions and in S. Wales. In some areas it was said to be prevalent but it was very variable in its effects. A species of *Olpidium* was found to occur in roots of plants affected by big vein. Tomlinson and Smith (*Rep. natn. Veg. Res. Stn, 1957-1961*) studied the disease. They found that while closely resembling *Olpidium brassicae* (Wor.) Dang. in morphology, the fungus associated with big vein was distinct in its pathogenicity. They also established that the agent causing the symptoms could be graft-transmitted. In more recent years the virus has become known as lettuce big vein virus (Tomlinson and Garrett, *Ann. appl. Biol.* 1964, **54,** 45-61) and the role of *Olpidium* in transmitting it has been understood. Plants from Pembroke which were stunted and chlorotic and had failed to heart contained **Arabis Mosaic** virus (Lister, *Rep. Scott. hort. Res. Inst. 1958-9*, 36).

Tip-burn (non-parasitic) was widespread in Worcs in several seasons, following hot sunny spells in spring. It became severe in the summer of 1958 on several Herts holdings both outdoors and on crops under glass and attracted attention in many places in Cambs in 1961. There was a number of other reports, occasionally of severe attack. Plants from a Kent crop were rejected by a wholesaler because of **Oedema,** and the trouble was noted elsewhere. Fine necrotic spotting of the lower leaves of a cv. May Queen crop in Wilts was attributed to **Manganese Deficiency**; while **Boron Deficiency** was involved in a field in Cornwall where 20 per cent of the crop showed necrotic stippling of the leaves and crowns had died. **Strangles,** due to wind damage, was local in Yorks and Lancs in April 1960. Crops in cold Dutch light structures and under frames in Worcs had puckered leaves with silvering of their lower surfaces: the condition was prevalent early in 1958 and was attributed to **Frost Injury.** The tips of young heart leaves and of the base of the mid-rib of older leaves were necrosed in a number of crops in Dutch light structures and this was thought to be an unusual manifestation of frost damage as it was invariably accompanied by the more familiar symptoms and no associated organism could be found. In April 1958, chilling symptoms in indoor and outdoor lettuces were prevalent in the South-western Region.

In 1959, damage to plants following the use of the, then new, soil sterilant metham-sodium, several weeks before planting, was seen in a number of

crops. Symptoms included chlorosis, curling of the marginal leaves, browning of roots, wilting and stunting. Plants were often severely checked. Root scorch was frequent in Yorks E.R. due to the use of the chemical. Since that time the importance of adequate cultivations following treatment, and the avoidance of too low soil temperatures at the time of treatment, has been realized and little trouble has been experienced with this material. An oval, brown lesion on one side of the hypocotyl just above soil level was a feature in crops giving rise to several enquiries in the springs of 1960 and 1961 in Yorks and Lancs. Sometimes the lesion extended round the stem and the plant died. Dicloran had been used in the seed bed in all instances and the symptoms were reproduced in experiments made by L. J. Cock: the use of this material in seed beds prior to sowing was not recommended by the manufacturer. Damage by hormone-weedkiller drift occasionally produced particularly severe effects in lettuce.

Mint

Rust (*Puccinia menthae* Pers.) was occasionally severe, and one 2-acre crop was almost completely affected. In April 1960, infection was prevalent on young shoots in old plantations in Norfolk. Warm-water treatment of dormant runners was being successfully used on some holdings. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was detected in specimens from 20 acres in Kent in which most plants were weak and badly defoliated.

Mustard

Both **Club Root** (*Plasmodiophora brassicae* Woron.) and **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were recorded. The former affected 76 per cent of a 3-acre crop, and the latter appeared to have caused appreciable loss in another crop. **Damping-off** (*Pythium* sp.) was also noted.

Onion

There were some heavy losses in parts of the Eastern Region in the 1957-harvested crop due to **Neck Rot** (*Botrytis allii* Munn and *B. byssoidea* Walker), and rotting was prevalent in the west Midlands. Attacks in these areas were moderate in the 1958 crop, but little appeared in the other seasons except that, in mid-Wales, more was seen late in 1961 than in recent years. Neck rot was markedly negligible in the 1959 crop. Priest and Wood (*Ann. appl. Biol.* 1961, **49**, 445-60) produced strains of *B. allii* resistant to chlorinated nitrobenzenes in culture. Some severe attacks of **Leaf Rot** (*Botrytis cinerea* Fr. and *Sclerotinia squamosa* (Viennot-Bourgin) Dennis) broke out in 1960, particularly on spring onions, and attack on leaves was prevalent in the Vale of Evesham in 1957, 1958, and 1960, being particularly severe in the latter year. Virtually absent in 1957 and 1959 and scarce in 1961, **Downy Mildew** (*Peronospora destructor* (Berk.) Casp.) was severe in only a few crops in 1960. It is rarely seen in the Vale of Evesham. Reports in 1958 indicated a greater prevalence than usual in War, and infection was general in some eastern

counties with severe attacks in some parts, moderate to heavy attacks locally, and a number of severe late attacks in Norfolk. In Beds severe and general outbreaks occurred that year. The function of the oospores was the subject of a paper by McKay (*Scient. Proc. R. Dublin Soc.* N.S. 1957, **27**, 295-307) who had found them long-lived and needful of a long dormancy period.

As usual, **White Rot** (*Sclerotium cepivorum* Berk.) occurred regularly in the onion-growing areas, being particularly noticeable in the west Midlands in 1957 and 1961, and in the Eastern Region in 1961. It was locally heavy in the east and in part of Hants in 1958, and again in the east in 1960. A slight attack was seen in a crop of potato onions, *Allium cepa* var. *solaninum*, in Berks in 1959. Coley-Smith and Hickman (*Nature, Lond.*, 1957, **180**, 445) investigated the stimulatory effect of the hosts, and extracts from their roots, on the germination of the sclerotia. Further work by Coley-Smith (*Ann. appl. Biol.* 1959, **47**, 511-8) indicated that the fungus was confined to species of *Allium*, and he also studied the length of life of the sclerotia in the soil, concluding that they are likely to have a long persistence in the absence of a host plant. Our present knowledge of the biology of the fungus was reviewed by Hickman and Coley-Smith (*N.A.A.S. q. Rev.* 1960, No. 50, 58-62) who also discussed the directions which they considered future research could advantageously take.

There were four records of **Shanking** (*Phytophthora* sp.) in 1958 but only one other—all were from southern counties. **Damping-off** and **Root Rot** troubles were very few and associated with *Corticium solani*, (Prill. & Delacr.) Bourd. & Galz., *Pythium* sp. and *Fusarium* sp. **Smut** (*Urocystis cepulae* Frost) occurred but rarely—there were only one or two slight attacks each year, all from Worcs. A 22-yd length of seedlings however was completely infected. Muskett (*Pl. Path.* 1958, **7**, 75) recorded the first known outbreak for N. Ireland, actually seen in 1951; no further records had been made there up to the date of publication. **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) was infrequent.

Symptoms agreeing with **Onion Yellow Dwarf** virus were noted in patches in a small Surrey crop in 1960. This virus is known to occur in several countries including some on the Continent and the U.S.A. Symptoms are short yellow streaks, first appearing at the base of the leaves and becoming distributed throughout the entire plant. The leaves tend to fall over. These features have been seen in this country from time to time in the past, but the identity of the virus had not been established (but see also Henderson, *Pl. Path.* 1953, **2**, 130-3; 'Virus Diseases of Shallots').

The range of diseases affecting onions and related species in Eire was discussed in a monograph by McKay ((*Publ.*) *agric. Inst., Dublin*, 1959) and control measures were briefly recommended.

Parsley

Leaf Spot (*Septoria petroselini* Desm.) appeared a few times in widely separated areas.

Parsnip

Canker was present in the growing areas of the Eastern Region: it

was particularly noticeable in 1960 crops, some of which were severely affected, but was almost absent in 1959 even in early-sown and late-harvested crops. The dry 1959 season brought less canker generally. Channon, continuing his investigations (*Rep. natn. Veg. Res. Stn, 1957*, 50) reported on the frequent association of a species of *Itersonilia* with cankers. He examined cankered parsnips from many areas in the east and west and found the fungus on more than 60 per cent of the roots from 53 places: a species of *Phoma* highly pathogenic to parsnips occurred on roots from five places. Later he studied (ibid. *1959* to *61*) the incidence of the disease relative to date of sowing and singling distance, the effect of applications of fungicide to soil, and the significance of *Itersonilia* on parsnip leaves. Selection and testing of lines of parsnip resistant to canker continued throughout the period at N.V.R.S.

Slight to moderate **Powdery Mildew** (*Erysiphe polygoni* Mérat) attacks were reported from Beds and Herts in 1957. Infection of samples of parsnip seed examined by the present author was occasionally detected, perithecia being present.

No mention was made in reports of **Downy Mildew** (*Plasmopara nivea* (Unger) Schroet.). **Violet Root Rot** (*Helicobasidium purpureum* Pat.) rendered much of an Essex crop unfit to market: the soil was silty clay and the field subject to waterlogging. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) appeared once.

A virus obtained from a mottled parsnip (*Rep. Rothamsted exp. Stn, 1961*, 106-7) was later given the name **Parsnip Mottle** virus by Watson, Serjeant and Lennon (*Ann. appl. Biol.* 1964, **54**, 153-66).

Pepper

Tobacco Mosaic virus was present in red peppers on a Hants nursery, and a disease which devastated a small crop of chilli peppers in Worcs in 1959 was associated with **Cucumber Mosaic** virus. Five per cent of the plants (*Capsicum frutescens* var. *grossum*) on a Lee Valley nursery in 1961 showed a pronounced mottle on the young growth and premature leaf fall. Often, brown lesions were present on the main veins of older leaves. Losses were severe, and both tobacco mosaic and cucumber mosaic viruses were isolated from the plants.

Radish

A few radish crops contracted **Canker** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) each year and the fungus was responsible for one instance of damping-off. Radishes, particularly cv. French Breakfast, in the Bristol and S. Glos area in 1957 lost quality due to the typical lesions which, when extreme, completely girdled the bulbs to give a severe strangles effect. There were half a dozen outbreaks of **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) during 1958-60. In one the fungus had produced islands of blackened tissue in the flesh. Black circular lesions and considerable cracking of the bulbs were features of other attacks. **Club Root** (*Plasmodiophora brassicae* Woron.) appeared twice in reports: in a badly diseased plot in

Yorks, mustard, swede and Brussels sprouts were completely infected while radish had only 0·5 per cent. **Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) was common in Yorks and Lancs in 1959 and said to be so in one district of Glos: attacks were few only, in other years.

Rhubarb

Armillaria Root Rot (*Armillaria mellea* (Fr.) Kummer) and **Crown Rot** (*Erwinia rhapontici* (Millard) Burkh.) were noted, as was a bacterial **Soft Rot** of the buds. Clark and Graham (*Pl. Path.* 1962, **10,** 31-3) made what was apparently the first record of *Pseudomonas marginalis* (Brown) Stevens causing a disease in rhubarb. They found that a wet rot of forced rhubarb on a nursery in Renfrewshire, Scotland in 1960 was associated with strains of this bacterium. Virus diseases in rhubarb were thought to be probably not uncommon. Arabis mosaic virus was known to be associated with **Mosaic** (Harrison and Winslow, *Ann. appl. Biol.* 1961, **49,** 621-33). This virus was confirmed in small stunted plants in the Starcross Sub-Region tested in 1961, but apparently-normal plants were later found to contain the virus. Rhubarb **Ring Spot** virus affected half of a crop in Yorks W.R.

Sage

Only **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was seen—on a Surrey crop. The previous record of this disease, in 1954, was also from Surrey.

Seakale

Black Rot (*Xanthomonas campestris* (Pammel) Dowson) was recorded in the South-eastern Region in 1957.

Shallot

Neck Rot (*Botrytis allii* Munn) was recorded in several areas; and **Yellows** (onion yellow dwarf virus: but see p. 97) once in Norfolk.

Spinach

Heavy local attacks of **Downy Mildew** (*Peronospora farinosa* (Fr.) Fr. f. *spinaciae* Byford) were reported in 1961 in Lancs. A few other outbreaks were investigated; in one, 75 per cent of 3 acres of winter prickly-seeded spinach was affected in Kent, with substantial loss of market value. In July 1958, plants from an irrigation trial at Efford E.H.S. were stunted and chlorotic, incidence being related to the position of the oscillating spray lines and whether irrigation had been given in 1958 only, 1957 and 1958 or (less extensive infection) in 1957 only. E. Lester reported that a species of *Phytophthora* agreeing with *P. cryptogea* Pethybr. & Laff., was copiously produced from roots and stem bases in the laboratory. No other

records of *P. cryptogea* on spinach were traced. The fungus was again isolated from plants from the irrigated plots the following year. A few outbreaks of **Phytophthora Root Rot** (*Phytophthora megasperma* Drechsl.) were noted in the South-eastern Region in 1960. Two instances of root attack by a species of *Pythium* were associated with irrigation in Bucks in 1959. On spinach beet, **Leaf Spot** (*Ramularia beticola* Fautr. & Lamb.) was very severe in a field in Worcs in 1959 and heavy throughout a crop in Sussex in 1961, but **Rust** (*Uromyces betae* Kickx) attracted little attention.

There were a number of moderate to very severe attacks of **Blight** (cucumber mosaic virus) in crops in the south-east of the country and in Dorset, in 1959, and substantial losses were incurred. The virus had not been bothersome in the South-eastern Region for 10 years or more. Several crops had to be ploughed in after attacks in Berks in March 1960, and virus appeared to have been very prevalent there that season. A 1½ acre Kent crop was virtually useless in 1961, and 80 per cent of an acre in Sussex was attacked. Badami (*Ann. appl. Biol.* 1958, **46**, 554-62), studying a spinach strain of cucumber mosaic virus, isolated in 1946, found that it had lost its ability to be transmitted by *Myzus persicae* in 1955. It had, however, retained the ability to be transmitted by certain other aphid species which are also vectors of others strains of cucumber mosaic virus, thus indicating a change in the strain, which had been readily transmitted up to 1955. **Beet Mosaic** virus was confirmed in perpetual spinach received from a crop in Kent in 1961 in which several plants were affected.

Tomato

On the whole, **Didymella Stem and Fruit Rot** (*Didymella lycopersici* Kleb.) had not been as destructive as in so many of the last 20 years except perhaps in places in 1958. Reduction in the size of plantations may account for the smaller amounts of infection seen outdoors in the Wye Sub-Region. In 1960 hardly any appeared anywhere in the country early in the season and very little developed later: in the East Midland Region the almost complete disappearance of the disease on holdings where it had formerly been prevalent appeared to some extent to be connected with the wide use of automatic irrigation equipment. Attacks were not often serious in 1957, nor in 1959, and caused little concern in 1961, except that, while many Eastern Region counties had less than usual, outbreaks were severe on many outdoors crops in Essex. Also, infection was rather above average in S. Wales, Devon and Cornwall that year, and in the Lee Valley, where it had been below normal earlier in 1961, infection increased considerably in a number of crops by the end of the season.

1958 saw frequent attacks in Yorks and Lancs: locally it was severe with some instances of 60-100 per cent infection. Unusually prevalent in the Northern Region, it also became widespread and severe in much of the Eastern Region, and in parts of Suffolk *Didymella* was said to be worse than for several years with up to 10 per cent of plants killed in August on some holdings and infection starting on outdoor fruit in June. Several outbreaks were serious in the Lee Valley in June with up to 30 per cent in some houses, and very rapid development in October badly affected many

nurseries, attacks probably being above average. Elsewhere in the country incidence was generally not severe in 1958.

Of the few reports mentioning the use of maneb, some indicated successful control of spread, one or two failures, and some crops were damaged by the fungicide. Captan has successfully reduced spread in some outdoor crops.

Past concern about *Didymella* was reflected in the great amount of research on the disease.

Knight (*Trans. Br. mycol. Soc.* 1960, **43**, 519-22) was able to group isolates of pycnidial fungi from tomato stems and fruits into those which attack both stems and fruits and those which attack fruits only. The former agreed with *Diplodina lycopersici* Hollós, the imperfect stage of *Didymella lycopersici*, while the latter could mostly be attributed to *Phoma destructiva* Plowr. with a few weakly pathogenic forms of *Diplodina*. She also recorded three further instances of perithecial formation in the field.

The work of Williams on some aspects of infection and the effect of temperature and plant nutrition on it, on spread by handling plants and by watering, and on the effect of other organisms in the soil on the activity of *Didymella*, is reported in the annual report of the G.C.R.I. for 1957-60 inclusive.

Knight and Keyworth (*Ann. appl. Biol.* 1960, **48**, 245-58) studied the sources from which infection comes in outdoor crops and ways of eliminating them, also how infection spreads. They investigated (*Ann. appl. Biol.* 1960, **48**, 259-69) control in outdoor crops by fungicides, finding maneb the most successful of those tried, while captan also gave good protective control but its eradicant properties were less satisfactory. Read (*Rep. Glasshouse Crops Res. Inst. 1959*, 112-5) also used captan with success.

Williams (ibid. *1960*, 68) concluded, from laboratory experiments, that metham-sodium and chloropicrin were probably capable of eliminating *Didymella* from contaminated glasshouse soil. This was of particular interest as steaming had sometimes led to high amounts of infection; steamed soil is prone to contamination by the fungus, which grows readily in it. Hughes *et al.* (ibid. *1960*, 79-82; *1961*, 83-6) compared soil treatments of chloropicrin, steam and metham-sodium, and determined the residues of methyl isothiocyanate in soil following the use of the latter. They were also concerned with the question of the phytotoxicity of this decomposition product of metham-sodium.

Williams and Hack examined the effect of certain soil treatments on stem rot, both in glasshouses (*Ann. appl. Biol.* 1957, **45**, 304-11) and in the laboratory (Hack and Williams, ibid. 1960, **48**, 236-44). They were mainly concerned with the establishment of *Didymella* in sterilized and unsterilized soils, how long steamed soil remains susceptible to contamination, and the survival of the fungus within the soil. In their laboratory work they explored what factors might be involved in the destruction of *Didymella* spores in soil and at what rate destruction takes place.

The testing of *Lycopersicon* spp. for resistance to the fungus was discussed by Knight and Keyworth (*Ann. appl. Biol.* 1960, **48**, 245-58). High resistance was found in a strain of *L. hirsutum* var. *glabratum*, and the Planting Breeding Section at Wellesbourne was trying to breed this character into *L. esculentum* (*Rep. natn. Veg. Res. Stn, 1957*, 49). Maude (ibid. *1959*, 40) reported that the F_1 progeny of such a cross using cv. Harbinger as one parent was also

resistant, but later Haigh and Slade (ibid. *1960.* 17) found larger numbers of susceptible segregants in the first and second back cross generations than was anticipated. The testing of progeny from crosses between the species, and the search for additional sources of resistance, continued at Wellesbourne.

From observations in Jersey, Phillips (*Ann. appl. Biol.* 1959, **47,** 240-53) concluded that careful composting will destroy *Didymella* in tomato refuse.

Croxall *et al.* (*Pl. Path.* 1957, **6,** 27-31) found good evidence that certain strengths of solutions of the systemic fungicide 2:4:6–trichlorophenoxyacetic acid (2:4:6–T), applied to soil or foliage, increased the susceptibility of tomato plants to infection, and this effect was also studied by Williams (*Rep. Glasshouse Crops Res. Inst. 1957,* 120-2).

In recent years, interest has been shown in the nature and significance of infection of the seed. Fisher had earlier (*Nature, Lond.* 1954, **174,** 656-7) shown that the fungus can invade the seed and is not solely a contaminant of the surface, while Phillips (*Trans. Br. mycol. Soc.* 1956, **39,** 319-29) showed that seed infection, while common, was likely to be of rare importance as a source of the disease in Jersey. Derbyshire produced additional evidence (*Pl. Path.* 1960, **9,** 152) of the transmission of the disease by infected seed, about which previous work had been somewhat conflicting; and Maude (*Ann. appl. Biol.* 1962, **50,** 105-11) confirming transmission by seed-borne infection, opined that this could occur in the outdoor crop under normal conditions of cultural practice, though it was more likely in the earlier-sown glasshouse crops.

As usual, stem, leaf and fruit rots and 'water spot' due to **Grey Mould** (*Botrytis cinerea* Fr.) were a problem in cold houses and sometimes serious in heated ones. Often, young plants or seedlings were rotted at the stem bases. In 1957, infection was more noticeable in the Lee Valley and some other places than normally, and often serious in the Valley though not elsewhere in the east. 1958 was a particularly bad year in many parts of the country but there was much less in the drier 1959, while in 1960 crops in the Midlands were especially affected.

On nurseries practising close planting in Norfolk, damage to leaves was considerable in 1958, and attacks were serious in Worcs in houses using overhead irrigation, as dull damp weather prevented drying of the foliage. Stems and leaves of cv. Baby Lee were badly affected, and fruits showed water spot, in a house in the south-east, but cv. Ware Cross plants in the same house were virtually free from infection. Baby Lee's habit of growth, which restricts ventilation and can lead to mechanical injury during cultural operations, was thought to account for this effect between cultivars. Studies still continuing at the Scottish Horticultural Research Institute, Mylnefield were giving particular attention to those physiological factors which affect susceptibility to infection and to ways of controlling stem infection with chemicals. Wilson had demonstrated that plants varying in physiological age also vary in their susceptibility to stem infection, and that *Botrytis* is able to survive as latent mycelium in the surface tissues of infected leaf scars for a period while no symptoms develop. He has reported on this work and on preliminary studies on the nature of the resistance mechanism (see *Rep. Scott. hort. Res. Inst. 1961-2,* 74-5).

Dicloran has been successfully used for controlling *Botrytis* diseases on

various hosts and its effectiveness on tomato has been discussed (Anon. *Chem. & Ind. (Rev.)*, 1959, 1065-6).

Leaf Mould (*Fulvia fulva* (Cooke) *Ciferri* syn. *Cladosporium fulvum* Cooke) has been frequent in glasshouses, but apart from Wales, where attacks were particularly heavy except in 1959 and 1960, it was not more prominent than usual except, as might be expected, in the damp conditions of 1958. In 1957, outbreaks were widespread and severe, with much more than usual, throughout Wales, whole crops being affected in many places by August: the Lee Valley had above average and often serious attacks that year. The hot summer of 1959 checked leaf mould nearly everywhere. The cultivars Syston Cross and Eurocross showed little or no infection in various N.A.A.S. trials in which other cultivars were more appreciably or even severely affected. Progress in introducing leaf mould resistance from species of *Lycopersicon* into cultivated varieties was reported (*Rep. John Innes hort. Instn, 1960*, 10). These breeding lines were being developed further at the Glasshouse Crops Research Institute, Littlehampton. Day (*Nature, Lond.* 1957, **179**, 1141-2) produced evidence of the mutation to virulence of an avirulent race of *F. fulva*, by means of X-rays. Wiggell (*Pl. Path.* 1958, **7**, 26-9) in trials in Yorks and Lancs, confirmed the earlier findings of Beaumont that nabam and zinc sulphate at high volume was the only fungicide to control bad attacks of leaf mould with any consistency.

The level of mercury residues in tomato fruits treated with phenylmercury salicylate aerosols in commercial crops in England and Wales, and Guernsey, in 1959 was investigated by Egan and Lidzey (*Pl. Path.* 1960, **9**, 88-91).

Blight (*Phytophthora infestans* (Mont.) de Bary) was mainly of concern in 1958, when the outdoor crop suffered very badly in many parts of the country. Though widespread and severe throughout eastern counties in September, some crops were kept clean with captan. Blight was frequent under glass in the north, on leaves and fruit. In 1960 it had appeared in most places by August and September, and was prevalent in many areas with some high losses in crops outdoors. Zineb and copper were said to be giving good control in the east Midlands. In September 1957, unusually severe and widespread attacks took place in the Eastern Region, with 30 to 40 per cent loss of fruit on some holdings: elsewhere in 1957, though common in some areas, it was severe only in War.

Blight was of no consequence in the hot dry season of 1959, and was not much in evidence in 1961 except in N. Wales where it was fairly severe in western districts. The usual type of blight symptoms on fruit were absent in an infected outdoor crop of cv. Harbinger in Kent. Instead, white or cream waxy areas developed on the fruit, within which the fungus was sporulating.

Crosse *et al.* (*Ann. appl. Biol.* 1960, **48**, 270-8) have investigated the *in vivo* antifungal action of streptomycin-copper chelate against blight in glasshouse tests. In view of the difficulties of control in 'blight years' by spraying, the possibilities of developing cultivars of tomato resistant to blight were being considered, and Goodman (*Grower*, 1957, **47**, 179, 181 and 183) has reported on tests at Johnstown Castle Agricultural College, Wexford on commercial cultivars and a number of lines obtained from both *Lycopersicon pimpinellifolium and L. esculentum.*

Verticillium Wilt (*Verticillium* spp.) was unusually common in the west Midlands in 1960 and to some extent in 1958. In 1961, outbreaks were rather more troublesome than usual in the east Midlands, the Lee Valley and N. Wales. While *V. alboatrum* Reinke & Berth. was often the culprit in the Lee Valley it had rarely been seen in the Wye Sub-Region during the previous 10 years though *V. dahliae* Kleb. has been abundant there during that time. In parts of a nursery in the south-west, infection was only serious where roots were damaged by lifting the containers. J. Knapman obtained a good practical control of the wilt in a heavily contaminated glasshouse soil with chloropicrin. During application in January, soil temperatures varied between 10·6 to 12·8 °C. The dosage was 3-5 c.c. per injection at a depth of 6 in., the distance between injections being one foot. Thirty-four gal per acre were applied and the chloropicrin was sealed in with water to give an approximately $\frac{1}{2}$-in. seal. On a nursery in the Lee Valley where chloropicrin was used wilt was severe, and on another this chemical was less effective than metham-sodium.

From the work of Selman and Buckley (*Trans. Br. mycol. Soc.* 1959, **42,** 229-34) it seemed probable that the fungus normally enters the xylem vessels mainly through wounds and not through living tissues. They studied the invasion process and factors affecting it. The results of Selman and Pegg (*Ann. appl. Biol.* 1957, **45,** 674-81), bore out the contention that a toxin produced by *V. alboatrum* is responsible for effects on the growth of tomato plants; and their later studies (Pegg and Selman, *Ann. appl. Biol.* 1959, **47,** 222-31) suggested that indole-3-acetic acid, or related substances, would be a component of that toxin. Threlfall (*Ann. appl. Biol.* 1959, **47,** 57-77) studying water relationships within the plant, found that the dwarfing and wilting associated with the disease resulted from an increasing lack of water within the plant. Following work he did in Connecticut, Wood (*Ann. appl. Biol.* 1961, **49,** 120-39) discussed the possibility that pectic and cellulolytic enzymes are produced in the xylem of infected plants and cause some symptoms of this disease. He pointed out the need for further work on this aspect.

Little had been known of the activity of *Verticillium* in the soil. The observations of Sewell (*Trans. Br. mycol. Soc.* 1959, **42,** 312-21) tended to show that conidial production in soil is important in the life-history of *V. alboatrum*, a feature rather overlooked in the past, and that the mycelial phase seemed to be very limited in soil. Williams (*Rep. Glasshouse Crops Res. Inst. 1961*, 68) found that shading affected symptoms caused by *V. alboatrum*, but not those caused by *V. dahliae*.

Kerr (*Trans. Br. mycol. Soc.* 1961, **44,** 365-71) determined how far certain organisms he isolated from tomato roots were antagonistic to *V. alboatrum*. The latter has no sexual stage, yet variation in pathogenicity is found; Hastie (*Rep. Rothamsted exp. Stn, 1960*, 126-7) had therefore been investigating asexual genetic recombination in *V. alboatrum*.

Fusarium Wilt (*Fusarium oxysporum* Fr. f. *lycopersici* (Sacc.) Snyder & Hansen), common in Guernsey, was not reported from England and Wales. Because the wilt was so destructive in Guernsey, Harrison and Burgess (*Pl. Path.* 1962, **11,** 23-5), following Dutch work in relation to verticillium wilt, have investigated the resistance to *Fusarium* of selected F_1 rootstocks from crosses between *Lycopersicon hirsutum* var. *glabratum* and *L. esculentum*

and obtained a good degree of resistance. McDonnell (*Nature, Lond.* 1958, **182,** 1025-6) found an absence of pectolytic enzymes in a pathogenic strain of this fungus: pectic enzymes have been thought to be of importance in symptom production and wilting.

Among the most common causes of failure each year were the associated disorders **Brown Root Rot** and **Corky Root,** with which several factors may be involved. As in other countries a grey mycelial fungus had frequently been isolated from affected roots and was able to cause the typical symptoms. Recently (Schneider and Gerlach, *Phytopath. Z.* 1966, **56,** 117-22) this fungus has been named as *Pyrenochaeta lycopersici* Schneider & Gerlach) and it is now known to cause decay of the cortex of thin roots early in the season and brown corkiness of older roots. The troubles were more widespread and severe than usual in the west Midlands in 1961, though plants on grafted stock K showed a high degree of resistance. The technique by which commercial cultivars are grafted onto resistant rootstocks began to look a promising and practical means of control. Some success was being achieved with nabam but metham-sodium was erratic in its effects.

Formerly, Ebben and Williams (*Ann. appl. Biol.* 1956, **44,** 425-36) distinguished three types of lesion associated with brown root rot—these were a cortical rot of fine roots, corky root and a basal stem rot. Ebben (ibid. 1959, **47,** 17-27) examined the fungi associated with the rhizosphere of affected plants and found that some of those isolated were either weak pathogens or secondary saprophytes. She compared the populations of fungi in steamed, fallowed and unsteamed plots and later (ibid. 1960, **48,** 817-23) examined the bacterial flora of the rhizosphere, including the effect of steaming on it.

Each year, **Black Dot** (*Colletotrichum coccodes* (Wallr.) Hughes) was commonly associated with root troubles, particularly in Wales. It was worrying in Worcs from 1957-9, being prevalent and sometimes severe particularly where soil had been sterilized infrequently: in 1957 many specimens from the county were examined, all with unusually severe infection extending well above soil level. In 1957, crops all over the west Midlands had particularly bad attacks in September, and the fungus was often serious in the Eastern Region in unsterilized soil. In the South-eastern Region in 1959, heavy attacks by *Colletotrichum* were often associated with fertilizer scorch, of which there were a number of cases; and vascular discoloration at the base of plants, accompanied by wilting, was pronounced.

Phytophthora cryptogea Pethybr. & Laff. was the most frequently cited cause of **Damping-off, Foot Rot** and **Root Rot,** though *P. nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. was commonly seen. These troubles are extremely common whenever soil sterilization has been neglected or inadequately done, and are reported particularly from the north of the country. On a holding in Lincs in 1958, *P. nicotianae* var. *parasitica* was found causing lesions high up the stem. *Pythium* spp. are sometimes involved, either alone or in association with *Phytophthora* or other fungi, and also *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. In 1960, *Rhizoctonia* caused more trouble as an agent of foot rot in the east Midlands than for some years. In Ches an area of a new house, previously cropped with potatoes, had rhizoctonia collar rot severely, while tubers of self-set potato plants showed black scurf. In the Eastern Region, collar rot was seen for

two years running on a nursery where the soil had been treated with metham-sodium, and in one or two instances elsewhere *Rhizoctonia* attacked seedlings growing in soil sterilized with this chemical. *Olpidium* sp. was very occasionally noted in association with plants with root rot. **Toe Rot** (*Phytophthora verrucosa* Alcock & Foister) occurred on a few nurseries only, in the Midlands, and what was probably this fungus attacked plants in a crop in Carms. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was common in Yorks and Lancs in some years.

Alternaria Blight (*Alternaria solani* Sor.) was severe in a garden in Caerns in 1960, and affected 30 per cent of a ¼-acre outdoor crop in Sussex in 1961. A record from Glos in 1957 makes up the total of reports of this disease during the five years.

Buckeye Rot (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.) was fairly commonly reported. Usually the lower trusses were affected and evidence of splashing was sometimes cited. In 1957 and 1960 it was generally above average in the South-eastern Region, often with considerable loss of fruit on the lower trusses in 1957, and above normal in Yorks and Lancs in 1960. Several outbreaks of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were noted; and galling of roots (Plate IV) due to **Powdery Scab** (*Spongospora subterranea* (Wallr.) Lagerh. f. *subterranea*) was seen a few times in the north, and on two other nurseries in Wilts and Cards respectively. In the latter attack, the affected cv. Ware Cross plants were wilting. A fruit rot attributed to *Pleospora herbarum* (Fr.) Rabenh. was seen in Staffs in 1957 on imported fruit.

Bacterial **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) was rather frequent in Yorks and Lancs in some years. **Bacterial Canker** (*Corynebacterium michiganense* (Smith) Jensen) which was found a number of times between 1942 and 1947, has rarely been seen since. The attack in 1942 was the first in Britain, and some concern was felt about the potentialities of the disease. However, although noted twice in 1949, and once each in 1951, 1954 and 1956, all in crops from imported seed, it has since made only the odd appearance in this country. Restrictions have been put on all imported tomato seed. Under current importation regulations, such seed must be accompanied by an official health certificate stating that the plants from which the seeds came were examined during the growing season and were found to be free from bacterial canker, or that the plants were grown in a region where the disease does not occur. Malcolmson (*Rep. Scott. Soc. Res. Pl. Breed. 1960*, 24-8) induced a foliar disease in tomato plants inoculated with *Bacillus subtilis* Cohn emend. Pratzmowski, an organism which she had found affecting the leaves of potato plants in a glasshouse.

Mosaic (tobacco mosaic virus) was widespread and undoubtedly caused considerable losses, but in 1958 was less apparent and not severe in most parts of the country other than a few eastern districts. Many glasshouses in the South-eastern Region were seriously affected in 1957, some of them completely so; as in the Evesham area and N. Wales, incidence and severity seemed well above average generally there in 1957. In the east, mosaic appeared early and symptoms were very severe. Particularly noticeable in 1959, the virus caused concern in parts of the west Midlands and was often severe in the Eastern Region and in a few other districts. The frequency and severity of mosaic was a feature of the 1960 season in the Northern

Region, the Evesham Area, the south-east and in many nurseries in Devon; while 1961 was marked by a greater frequency than usual of a severe strain or strains giving striking yellow symptoms in Yorks and Lancs, Herts and the south-east. Also associated with these strains have been an eventual bronze coloration of older leaves and often a green streaking of the stems; on one nursery the younger foliage showed some necrosis. Mosaic was a serious problem in the South-eastern Region in 1961, especially in the early crop under heated glass, but by increasing the nitrogen in the liquid feed, or by applying a top dressing of nitrogen, some reduction in the severe effects of infection was obtained.

Confirmation of the virus in bronzed fruits which were confined to the lowest trusses was made in several attacks in the Wye Sub-Region: in one house the plants showed no other virus symptoms though many other plants in the house did.

In 1961, infection by the tobacco strain was confirmed in cv. J.R.6, grafted onto rootstock 'KV' at Evesham, but in all other instances in the Evesham Area up to May that year, infection by the tomato strain was confirmed. None of the 15 mosaic-infected specimens sent to Dr. L. Broadbent from the Lee Valley during 1961 contained the tobacco strain.

Mosaic was said to be very noticeable on grafted plants in the Evesham Area in May 1961. On a nursery in Worcs, very severe symptoms developed on J.R.6. grafted onto rootstock 'KV', while in an adjacent row the same cultivar on its own roots was symptomless, and plants grafted onto rootstock 'K' were virtually unaffected. In a crop in Surrey, cv. Florissant plants grafted onto 'KN' showed infection, but no symptoms were seen on ungrafted plants.

The more severe form of mosaic, known as streak, caused some severe losses. The aucuba form was seen in the west Midlands, the Lee Valley, the Wye Sub-Region and the South-western Region, but only occasionally during the five years: a spectacular outbreak was confirmed on a nursery in mid-Wales. **Mixed Virus Streak** (tobacco mosaic virus + potato virus x) was noted on a number of nurseries and was sometimes severe. In two tomato crops in Devon in which potato plants were present, mixed virus streak occurred only where the grower had tried to remove them, which suggested the particular importance of handling of the plants as a factor in spread compared with contact between potato and tomato plants.

Broadbent (*Rep. Glasshouse Crops Res. Inst. 1960*, 96-116) reviewed the literature on the epidemiology of tomato mosaic. His own studies on the subject with the object of discovering more about the initial sources of the virus, its effect on yield and possible control measures have been discussed in the annual reports of the G.C.R.I. for 1959 to 1961. He reported (ibid. *1961*, 74-5) on a survey carried out in commercial tomato crops, in co-operation with the N.A.A.S., which demonstrated the rarity of smoking tobacco as a source of TMV in tomato crops in this country. Of 203 samples of foliage sent in to him during 1960 and 1961, 187 were infected with a strain of TMV causing tomato mosaic, which differed from the strains found in smoking tobacco. In only four samples of grafted plants from one nursery, was the tobacco strain found.

Interest has been shown in ways of freeing seeds from the virus. Howles (*Pl. Path.* 1961, **10**, 160-1) was able to reduce the content of TMV in tomato

seeds to a low level by heating the seed for 22 days at 72°C: previously he (*Pl. Path.* 1957, **6,** 46-8) had obtained similar reductions of mild TMV by using 2-chlorophenoxyacetic acid. The cure of virus-infected plants by chemical treatment would be a great asset and has been given some attention. However, Howles (ibid. **6,** 46-8) failed to cure infection in tomato plants by applying certain chemical solutions to the soil or spraying them onto foliage, though malachite green delayed virus multiplication and symptom development. Again, the same worker (*Rep. Glasshouse Crops Res. Inst. 1958*, 87-8) found that a number of chemicals capable of inactivating viruses *in vitro*, when introduced into tomato plants systemically, had little effect on the spread of TMV from infected to healthy plants. No striking effects, under the conditions of the trials, were noted by Winsor and Long (ibid. *1961*, 51-2) when they sprayed solutions of urea onto leaves of virus-infected tomato plants.

Bronzing of fruit had often been noted in association with symptoms of mosaic on the plants. Inoculation experiments at the Lee Valley Experimental Horticulture Station (*Report, 1958/9*, 27-30) made it appear that while plants infected with TMV may produce bronzing in unripened fruits, similar symptoms can be due to other conditions entirely.

At John Innes Horticultural Institution (see annual reports for 1959-61 incl.), Dawson concentrated on finding out whether lines resistant to TMV can be bred, and the genetics of resistance has been studied. How far the virus affects the resulting crop was being investigated at Efford Experimental Horticulture Station (Report for 1961) in unheated structures.

Harrison (*Nature, Lond.* 1961, **192,** 90-1) showed that there may be a relationship between the hollow fruit condition and infection by TMV. Merrett (*Ann. Bot., Lond.*, N.S. 1960, **24,** 223-31) found that tissues in tomato stems infected by aucuba mosaic virus respired at a lower rate than did healthy tissues; while Caldwell (*Nature, Lond.* 1959, **83,** 1142) still found a little residual activity by aucuba mosaic virus in leaf tissue which had been dried and stored for as long as 24 years.

Reports contained relatively few comments on **Cucumber Mosaic** virus but symptoms were common and very severe in outdoor tomatoes in 1957 in the Eastern Region and it was above average in 1957 in N. Wales. There were a few other reports of widespread infection in individual crops. It was present in some instances when samples with fern leaf symptoms were tested.

Apparently, tomato **Spotted Wilt** virus was also not particularly common and its significance was declining. How temperature and day length influence the response of plants to infection by this virus was studied by Selman and Grant (*Ann. appl. Biol.* 1957, **45,** 312-7) who also (ibid. 1957, 448-55) found that an increased nitrogen supply above that optimal for growth increased both the virus content of plants and their susceptibility to systemic infection. Selman and Milne (*Pl. Path.* 1961, **10,** 100-4) described a new local lesion assay method for this virus, and using it, followed changes in infectivity for periods up to 64 days after inoculation.

The severity of tomato **Aspermy** virus varied. In 1957 it was probably above average in the extreme south-west and the Scilly Isles, outdoors and under glass, and it attacked a few outdoor crops in the south-east quite severely. All the reports received except for one in Yorks and Lancs in

1958, which was a new Regional record, came from south of a line extending roughly from the Wash to Aberystwyth. In fact all the reports we have received since aspermy was first observed in this country in 1944 (Blencowe and Caldwell, *Nature, Lond.* 1946, **158,** 96-7) have come from south of this line.

Govier (*Ann. appl. Biol.* 1957, **45,** 62-73) gave evidence to confirm the view that tomato aspermy virus is a strain of cucumber mosaic virus, as did Graham (*Virology*, 1957, **3,** 427-8), independently, by demonstrating cross protection between strains of the two viruses in tobacco plants.

Harrison (*J. gen. Microbiol.* 1958, **18,** 450-60) showed by serological methods that beet ring spot and potato bouquet viruses are strains of tomato **Black Ring** virus, and Cadman and Harrison (*Virology*, 1960, **10,** 1-20) studied the behaviour of this virus in soil and discussed its transmission possibly by an eelworm.

A foliar necrosis of the F_1 hybrid cultivar Syston Cross was drawn to the attention of Dr. Day of the John Innes Horticultural Institute in June 1957. Day (*Pl. Path.* 1958, **7,** 57-8) concluded that the cause was almost certainly associated with the presence of a gene for resistance to leaf mould. Langford (*Canad. J. Res.* C., 1958, **26,** 35-64) had formerly described a similar trouble, which he called **Autogenous Necrosis,** in tomatoes immune from the leaf mould fungus. It was observed in Britain that the necrosis did not occur in association with leaf mould susceptibility,

Observers noted that not all plants were affected in any particular batch, though the amount varied, and that affected plants usually occurred singly. Hot sunny weather was apparently ideal for the expression of symptoms. In 1957 the trouble was apparent during the summer in most parts of the country wherever Syston Cross was grown. In the east it caused serious damage in some crops.

Yellow spots appeared on leaf areas which became necrotic in the centre and eventually developed concentric rings. The tips of the lower leaves tended to become yellow or brown and to hang downwards and a slight blackening and necrosis of the flower pedicels appeared to be typical. There were several reports from the east Midlands in 1959 and 1960, but only one or two from elsewhere in 1958-61. Symptoms resembling autogenous necrosis have also been seen in the odd crop of cvs. J.R.6, Grower's Pride and Resistor.

The hot weather of 1959 made this the year in which **Blossom-end Rot** was most prominent. Incidence was high in many parts of the country. On two nurseries in the south-east an association of the trouble with a high concentration of salts in the soil was established. Attacks were heavy locally in a few areas only, in 1957 and 1960, but little was seen in 1958 and 1961.

Blotchy Ripening, a collective name for a number of fruit maladies, was more prevalent than usual in Worcs both in 1958 and 1960. In 1958 quite a lot was reported from Eastern Region counties and it was general in the south-east in 1959. Apart from the Lee Valley, where there have been some severe attacks in several of the years, very little trouble was reported in 1957 and 1961. Cooper who had given a critical review (*Rep. Glasshouse Crops Res. Inst. 1956*, 39-47) of the literature on this and allied disorders of the tomato, described (ibid. *1958*, 64-5) equipment for use in observations of the effects of temperature on the colour of tomato fruits on the plant.

In *Ann. appl. Biol.* 1958, **46,** 669-74, Cooper discussed a possible classification of the abnormalities of fruit pigmentation in cv. Potentate. Also Winsor (*Rep. Glasshouse Crops Res. Inst. 1959,* 83-8) discussed a grading scheme suitable for research purposes, in relation to manurial trials at G.C.R.I. during 1959. Butters (*J. Sci. Fd Agric.* 1960, **11,** 202-12) found that the percentage of blotchy ripening decreased as the soil pC value became lower. The composition of normally ripened tomato fruits, and of those with blotchy ripening, was compared by Winsor and Massey (ibid. 1958, **9,** 493-8).

Environmental factors which might affect blotchy ripening and similar disorders have been studied at the Lee Valley Experimental Horticulture Station (*Report, 1958/9,* 9-16).

Each year, fruit **Bronzing** has commonly been seen, especially affecting the early-formed trusses. Bronzing symptoms could be found on plants with or without symptoms of tomato mosaic. Considerable damage was caused in eastern counties in 1957 and 1958. There was a certain amount of loss due to **Fruit Cracking** on some nurseries in N. Wales in 1957. **Cat Face** was noted rarely, while **Dry Set,** resulting from failure of pollination, was said to be general and severe in Middx in 1959. **Green Back** was severe in a crop in Glam in 1957 but otherwise received no special mention.

Brown Pith Necrosis, a condition in which pith breakdown makes the stem hollow, and dark streaks occur on the stems, has been noted mainly in the south. Sometimes bacteria were associated with the breakdown. In the south-west, crops on steamed soils containing high amounts of nitrogen seemed the most likely to suffer.

Magnesium Deficiency was noticeably severe in the Vale of Evesham in 1958 and 1960. Messing *et al.* (*Rep. Glasshouse Crops Res. Inst. 1957,* 99-107) have tried sprays on foliage, and soil treatments for control in glasshouses. **Manganese Deficiency** was also mentioned in reports. There were a few instances of **Sun Scald,** which was unusually common in Worcs in 1959. A high percentage in seedlings of 10 selections of a cross between cvs. Baby Lee and Harbinger showed **Chimaera** on a nursery in Monmouth: on a holding in Caerns, while only cvs. Moneymaker and Ware Cross were affected, every plant of these showed symptoms of this trouble. 'Blueing' of plants, associated with cold, was sometimes noted in crops. A cold check was believed to be responsible for distorting the cotyledons in a crop in I.W.; distortion was associated with separation of the lower epidermis, and the first rough leaves showed fern-leaf symptoms. On two nurseries, *Pyronema confluens* Tul., colonizing the surface of incorrectly heat-sterilized potting soils, competed for nutrients with tomato seedlings which were eventually starved.

Silver Sector was a common feature on the leaves of several cultivars such as Potentate, Baby Lee and Ware Cross. In this condition the light grey sectoring varies from slight mottling to large areas, even covering the whole leaf, and may occur on the stems. Severe effects can include the entire growing point; and inflorescences borne on completely affected tissues are sterile and no fruit is set. The 'silvering' is due to the presence of abnormal palisade cells. Watkin Williams (*Rep. John Innes hort. Instn, 1960,* 9-10) found indications that silver sector may be associated with chromosome breakage in the meristematic region; it was not transmissible by grafting.

The most serious trouble in the propagating stages in some years in the Lee Valley, and one which had increased in importance, was associated with toxic levels of ammonia and manganese, and sometimes with high levels of chloride after steaming. Symptoms included down-curling and mottling of the leaves. Ammonia occasionally damaged plants in other areas, originating either from compost or soil which had been steam sterilized.

Injury by various chemicals often featured in reports. Spray drift from weedkillers of the hormone type, and contact with sodium chlorate, were sometimes implicated, and occasionally fungicides or insecticides, sometimes applied at incorrect strengths, caused damage. Fumes from paraffin stoves, and creosote or other wood preservatives, adversely affected a few crops, and so did hormone sprays used for fruit setting.

The radicles of 25 per cent of 3,000 tomato plants on a nursery in Ches were swollen at or below ground level and/or constricted above ground. The soil had been treated with dicloran at the correct strength for lettuces. While lateral splitting above the swelling with toppling of the plants was frequent, not many plants were killed and adventitious roots developed on plants whose bases had been earthed up following heeling over. Planting had been done when the temperature was over 21°C so that the plants wilted, which may have made them more susceptible. Similar symptoms were produced at the Regional centre using dicloran at strengths in excess of those recommended.

In a number of instances, maneb applied to stem bases to control *Didymella*, caused severe damage in glasshouse crops. Symptoms included slightly sunken corky lesions at the base of the stems and corky lesions on roots, with sloughing off of the cork and discoloration of the wood. Wilting of plants, with discoloration of wood, following the use of maneb sometimes took place without root symptoms.

Metham-sodium soil sterilizers became available in the latter part of 1958 and were widely used on nurseries. Unfortunately many crops suffered damage in the 1958/9 season due to the phytotoxic nature of methyl isothiocyanate, the breakdown product of metham-sodium. Symptoms in the Lee Valley were a down-curling of leaves, particularly the terminal leaflet and an in-rolling of the leaflets. Sometimes leaves were simple and strap-like. Symptoms described from other areas included dwarfing, cotyledons being small and curled downwards at the margin. Later-leaves appeared feathery, plants tended to be leggy and developed a 'staring' habit. Some observers reported killing of roots when plants were put out into fumigated soil, but regeneration was also seen. Plants affected were either set out directly into soil previously treated, or moved into propagating houses in which border soil had been earlier fumigated, or growing in houses where soil in adjoining houses had been treated. Periods ranging from 3-12 weeks from fumigation to planting or moving into treated houses were involved. The difficulties mainly arose through failure to get rid of the toxic vapour from the soil before planting-up and have been overcome by improving the aeration by extra cultivations and by extending the period between treatment and planting. Hunnam and Waddington (*Pl. Path.* 1961, **10,** 118-21) investigated experimentally the amounts of toxic gases needed for damage to occur in glasshouses.

Vegetable Marrow

Widespread and unusually severe attacks of **Powdery Mildew** (*Erysiphe cichoracearum* Mérat) appeared in Worcs in 1959, but there were few other reports. **Cucumber Mosaic** virus affected many crops, sometimes badly, in the Midlands in 1961, and was reported to be widely distributed in E. Suffolk in 1958 and very severe on some holdings. There were several bad attacks in these and other years. Ninety per cent of a $\frac{1}{5}$-acre crop in Kent was affected with the **Cabbage Black Ring Spot** strain of turnip mosaic virus.

Watercress

Since the discovery of **Crook Root** (*Spongospora subterranea* (Wallr.) Lagerh. f. *nasturtii* Tomlinson) (Plate III, 2) in Wilts in 1947, all the main growing areas in the country have been found to have infection. By the early 1950's it had become of extreme concern to the industry. Brown watercress (*Nasturtium officinale* R. Br. X *N. microphyllum* Boenn. ex Rchb.) proved to be more prone to attack than green (*N. officinale* R. Br.) and the effects of attack were more apparent during the winter months. Some beds in Wilts became useless, in November 1958. It was fairly widespread in the east Midlands in the winter of 1959/60, markedly affecting cropping in some areas: it was severe also in all beds in Hants, and losses in the South-western Region were considerable.

The dry summer of 1959 reduced the flow of water from springs and bore-holes to many farms in Wilts and Dorset: generally those farms where the water supply was adequately maintained and well managed suffered less from the disease. In the winter of 1960/61, damage was appreciable in some Kent beds in the absence of control measures. Crook root was newly recorded in N. Wales in 1960. The many other reports during the five years showed how common crook root was but attacks were not particularly serious.

On a Lincs farm, a much greater severity was observed on those parts of the bed 'pulled' immediately before a short cold spell in December 1957, while plants in areas of bed 'pulled' some 10 days earlier showed only moderate root infection and appeared to be almost normal. In one bed there was a sharp line of demarcation between good and bad areas. These were taken as indications that weather conditions might influence the disease to a greater extent than had hitherto been supposed. The most destructive phase of the disease in the 1959/60 winter in the south-west was seen after the spells of hard weather in January 1960.

Tomlinson studied the role of calcium bicarbonate in inhibiting the disease (*Ann. appl. Biol.* 1958, **46,** 593-607), and the effects of zinc, in the form of zinc-fritted glass added to the water in the beds during field trials (ibid. 1958, **46,** 608-21) (see also *Rep. natn. Veg. Res. Stn, 1957* to *1961* inclusive). Control of crook root by zinc frit treatment has since been widely practised though toxicity effects have been experienced on some farms. Zinc-induced iron deficiency following the use of zinc frit had become a pressing problem in the South-eastern Region in 1958. In *Trans. Br. mycol. Soc.* 1958, **41,** 491-8, Tomlinson described the causal fungus, named it, and discussed the the relationship between it and its host. Till and Hooper (ibid. 1960, **43,**

460-1), in preliminary trials, studied the action of dilute sodium hypochlorite when drip-fed into the source water. Tomlinson (*N.A.A.S. q. Rev.* 1960, **12**, 13-9) reviewed the progress of research since the discovery of crook root, pointing to the need for future field trials, possibly over several years. He discussed initial trials using zinc in a soluble form, i.e., as zinc sulphate.

In the winter of 1957/8, **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) caused economic losses in several beds in Oxon, and there were two bad attacks late in 1960 in the south-east. On a Hants farm in 1961 it appeared to be present only on the crook root infected plants and not on the healthy plants receiving zinc drip.

Cabbage Black Ring Spot (strain of turnip mosaic virus) was prevalent in a Wilts locality late in 1958, extensive in a bed in Oxon the following season and noted in Kent in November 1960. Some Dorset beds were badly attacked at the end of 1960 and where crook root was also present, effects were particularly severe. The whole of a bed of green cress in Kent appeared to be infected in March 1961 and there were a few other records from the south-east of the country.

Tomlinson (*Rep. natn. Veg. Res. Stn, 1955*, 51) reported that virus-like symptoms were prevalent that year in all commercial crops examined except for a few raised from seed. The studies of Tomlinson and Smith on the disease caused by watercress **Mosaic** virus were reported in ibid. *1957*, 48. According to these workers (ibid. *1959*, 40), by 1959 mosaic had been greatly reduced in many farms by growing green watercress from seed. Rapid infection occurred on some farms, however, when healthy stocks were planted near old infected ones.

Diseases of Fruit

Apple

Apple **Scab** (*Venturia inequalis* (Cooke) Wint.) infection weather in England and Wales for (1956 and) the first four years of the five has already been discussed (Preece and Smith, *Pl. Path.* 1961, **10**, 43-51). Preece also examined the significance of spring rainfall in the same and earlier years (ibid. 1961, **10**, 52-3).

In general, little scab developed in the 1957-60 seasons inclusive in orchards which were efficiently sprayed. In 1961 more leaf scab was seen than for some years.

Following infection weather in the last week in March 1957, first lesions were seen, at early green cluster stage, throughout the country during the last week of April. Earlier in April, lesions had been recorded only in N. Wales and the south-west. There was very little further development, and scab in 1957 remained exceptionally slight: most of the country had experienced unusually dry weather from April until the weather broke in July. In 1958 the first widespread infection weather occurred at late green cluster, about 24-28 April, and the first lesions were recorded on 17-26 May. Scab seldom became serious where efficient spraying was done: it developed severely in many unsprayed orchards but absence of scab was not always associated with efficient spraying. Some infection built up in the east at the end of the season after spraying stopped, and in the South-eastern Region scab developed late on the tips of leaves, giving wood lesions in some cases, apparently irrespective of the spray programmes. In the extreme south-west, prolonged spells of high humidity forced growers to spray weekly, and some made as many as 17 applications.

In 1959, scab weather followed bud burst and, about a month later at the end of April and beginning of May, infection was seen at places throughout the country. Infection weather recurred during 15-17 April. Although the level of scab was often high early on, the dry summer checked development. The disease was troublesome only in some orchards where spraying was inadequate following the early infection periods. The first lesions for 1960 were noted during 26 April to 4 May. Except, briefly, on 12-13 April, widespread infection weather was absent from bud burst until petal fall began. During petal fall, infection conditions were pronounced and many growers reported lesions at fruitlet stage, especially in some Kent areas. Scab was mostly slight and well controlled in most orchards in 1960.

In 1961, infection weather occurred, at green cluster, from 29 March to 5 April and first lesions were seen, at pink bud, from 19-30 April. Another period of general infection weather came at pink bud from 19-27 April and, in the south-east, an important spell came at early petal fall, during 30 April to 4 May. Scab on leaves was at a higher level in 1961 than for some years. However, except in the Midlands, very little or no infection occurred on fruit in commercial orchards at picking time or after storage.

The Plant Pathologists of the N.A.A.S. collaborated with the Meteoro-

logical Office in recording infection periods during the spring in the main apple-growing areas, and warnings were given locally by the advisory pathologists. Alternative methods, i.e. using either Mills periods or Smith periods, of detecting nation-wide times of occurrence of scab in spring were found to work equally well (Preece and Smith, *Pl. Path.* 1961, **10,** 43-51). However, from surveys by the N.A.A.S. Plant Pathologists in each season from 1958-60, it appeared that growers had applied from five to nine sprays, largely at fixed intervals, to both Cox's Orange Pippin and Bramley's Seedling, using mainly captan and organomercury sprays respectively on the two cultivars (Preece, ibid. 151-8); and the surveys revealed that bud stages and infection weather were mostly disregarded in relation to timing.

Research on fungicides continued. Applications of concentrated lime sulphur were shown to be as safe and effective as those of the dilute chemical (Moore, *Ann. appl. Biol.* 1957, **45,** 11-8; ibid. 1961, **49,** 254-66; Glasscock and Storey, *Expl Hort.* 1960, No. 3, 42-5). Trials continued to show the reliability of captan as a safe fungicide (Moore, Kirby and Bennett, *J. hort. Sci.* 1961, **36,** 18-27; Kirby and Bennett, *Rep. E. Malling Res. Stn, 1960,* 113-5). Other potential fungicides were being studied (see annual reports of Long Ashton Research Station—Byrde and his colleagues) and research on the possible use of antibiotics was not neglected (Rhodes *et al.*, *Nature, Lond.* 1961, **192,** 952-4). The annual reports of the Long Ashton and East Malling Stations indicate the attention being paid to phytotoxicity problems in the use of mercury, or of copper (see also Llewelyn, *Ann. appl. Biol.* 1957, **45,** 376-84). Mercury residues on the fruit (Smart, *Pl. Path.* 1961, **10,** 158-60) and the effect on the soil of heavy applications of copper to trees (Hirst, Le Riche and Bascomb, ibid. 105-8) were other problems under consideration.

The frequency of airborne spores in orchards was investigated by Hirst and Stedman (*Ann. appl. Biol.* 1961, **49,** 290-305) and the role of dew in ascospore release by Moore (*Pl. Path.* 1958, **7,** 4-5). A periodic acid-Schiff staining technique was found to be effective in the early detection of scab lesions (Preece, ibid. 1959, **8,** 127-9). Rootstocks were listed according to their observed susceptibility (Moore, *Pl. Path.* 1960, **9,** 84-7). Scab was noted on wood of cv. Bramley's Seedling (Preece, ibid. 1961, **10,** 39-40) for the first time. Hirst (*Pl. Path.* 1957, **6,** 57-61) described a simplified surface-wetness recorder.

During the 1950's, the significance of **Powdery Mildew** (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) increased considerably, and in the five seasons under discussion it was widespread and severe throughout the main apple-growing areas. Secondary infection seemed less obvious in 1958 presumably due to the very wet conditions.

The worst attacks came in 1961. In the west Midlands, that year, it was said to be particularly severe in orchards suffering root injury owing to the wet soil conditions of the previous winter: in some of these as many as six dinocap sprays failed to stop a build-up by picking time. In the Evesham Area it was extensive in orchards where little had been seen in the past; while in the Eastern Region the outbreaks in 1961 were regarded as the worst within living memory.

Various factors may have been responsible for this increased prominence. Organic fungicides such as captan with, unlike lime sulphur, little or no

effect on mildew (Byrde, Clarke and Harper, *J. hort. Sci.* 1958, **33,** 244-53) had been increasingly in use against scab: experience showed the necessity of using dinocap to take account of mildew when captan replaced lime sulphur in the spray programme. In East Anglia the continued use of renewal or regulated pruning techniques rather than the more drastic spur pruning may have contributed to the increase of shoot mildew.

The mechanism of overwintering (*Rep. agric. hort. Res. Stn Univ. Bristol, 1957,* 114-23) and the role of secondary infections in mildew spread (*J. hort. Sci.* 1960, **35,** 66-72) were studied in detail by Burchill. In their studies on leaf waxes, Martin, Batt and Burchill (*Nature, Lond.* 1957, **180,** 796-7) found a fungistatic effect to *P. leucotricha* conidia of waxes of certain apple cultivars.

Great interest was being shown in alternatives to lime sulphur for mildew control (see annual reports of East Malling and Long Ashton Research Stations for the period, and the series of papers in *Proc. Br. Insecticide Fungicide Conf. Brighton, 1961,* **1,** 197-238). Moore (*Ann. appl. Biol.* 1957, **45,** 11-8; ibid. 1961, **49,** 254-66) found lime sulphur in concentrate form to be as safe and effective as in the conventional dilute sprays. The value of early spring applications of DNC-petroleum emulsion was demonstrated by Moore and his colleagues (*Rep. E. Malling Res. Stn, 1958,* 103-5; ibid. *1961,* 97-100) and by Waugh (*Rep. agric. hort. Res. Stn Univ. Bristol, 1959,* 115-7).

An observed effect of Epsom salts on mildew on potted rootstocks was investigated by Ford and Frick (*Rep. E. Malling Res. Stn,* 1960, 81-4; *1961,* 91-3), who concluded that susceptibility to mildew was unrelated to the magnesium status of the plant and that Epsom salt foliar sprays have a direct fungicidal effect.

Baker discussed the effect of winter and spring pruning on incidence (*Proc. Br. Insecticide Fungicide Conf. Brighton, 1961,* **1,** 179-84) and the use of a method of field assessment of the disease (ibid. 173-8) which she had described earlier (*Pl. Path.* 1961, **10,** 32-7).

The inheritance of mildew susceptibility in apple was being studied at John Innes Institute (Brown, *Euphytica,* 1959, **8,** 81-8). Moore (*Pl. Path.* 1960, **9,** 84-7) listed apple rootstocks according to their susceptibility to mildew and to canker.

The worst consequences of **Canker** (*Nectria galligena* Bres.) were in Essex, where it was very severe, particularly so in 1957 and 1961. In the south-west also, the disease was causing concern. In Norfolk in 1958, damage was appreciable; and the Evesham Area had more than usual in 1960. In the Wye Sub-Region, canker was noted as excessive in hill orchards 600 feet above sea level. Elsewhere there were widespread severe attacks in individual orchards. In Ireland, Loughnane and McKay (*Pl. Path.* 1959, **8,** 113) reported an unusual, profuse, development of the perithecia on current-season shoots of cv. Laxton's Superb. Moore and Bennett (*Rep. E. Malling Res. Stn, 1959,* 85-91) found the incidence of canker on rootstocks to be greatly reduced by two copper sprays in the autumn. Sharples (*Rep. agric. hort. Res. Stn Univ. Bristol, 1958,* 125-7) sought to establish criteria for distinguishing between lesions due to *N. galligena* and those due to *Gloeosporium perennans,* in the absence of fructifications. The origin of crotch cankers was studied by Waugh and Byrde (ibid. *1959,* 112-4).

Sewell (*Rep. E. Malling Res. Stn, 1956*, 168-9) stated that **Collar Rot** (*Phytophthora cactorum* (Leb. & Cohn) Schroet.) was first diagnosed in England in 1953 and had since been confirmed in Essex, Kent, Sussex and Worcs: in his opinion there was little doubt that the disease was widespread in England but only locally was it of serious economic importance. During 1957-61 infection was recorded by advisers in a number of orchards in those counties, and also at Wisbech and in Herefs, Suffolk, Hants, Berks, Som and Devon, In 1961 it was thought to be on the increase in the Eastern Region and a few really serious outbreaks were recorded. Sewell and Wilson (ibid. *1958*, 155-6; *J. hort. Sci.* 1959, **34**, 51-8) reported on resistance trials with some apple rootstocks. *Phytophthora* sp. was detected in dead buds and laterals on maiden cvs. Cox's Orange Pippin and Worcester Pearmain trees in Kent in April 1960: an association with heeling-in of soil was postulated.

The common *Coniothecium chomatosporum* Corda was noted as associated with **Branch Blister**: the fungus has for long been regarded as a saprophyte when accompanying this condition. In 1957, **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) was serious in an orchard of cv. Tydeman's Early Worcester in Essex causing cankers at pruning wounds on young vigorous trees. Both **Surface Canker** (*Pezicula corticola* (Jørgens.) Nannf.) and **Bark Canker** (*Phacidiella discolor* (Mouton & Sacc.) Potebn.) were noted by advisers, while **Die-back** (*Valsa ambiens* (Pers.) Fr.) was identified in Dorset on trees on which a flame-gun had been used to control *Nectria* cankers.

Verticillium Wilt was described by Sewell and Glasscock (*Pl. Path.* 1958, **7**, 76) following the isolation of *Verticillium alboatrum* Reinke & Berth. from branches in a Kent orchard. In 1958 this fungus was isolated from wood from the base of a young cv. Worcester Pearmain tree in Hants. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were not infrequently seen and the former was severe in a few orchards.

Spur Canker (*Sclerotinia fructigena* Aderh. & Ruhl.) and **Blossom Wilt and Spur Canker** (*Sclerotinia laxa* Aderh. & Ruhl. f. *mali* (Wormald) Harrison) caused no concern and reports were very few. **Bud Rot** (*Gibberella baccata* (Wallr.) Sacc.), which is of seasonal occurrence, was particularly in evidence in 1959. The previous wet autumn may have predisposed the trees to the condition. Individual orchards of the susceptible cultivar Grenadier, in Herefs, Kent and the Wisbech Area, were extensively affected while in other orchards in these areas severity was variable. In a Herefs orchard, 75 per cent of the buds of Grenadier were killed but only 10 per cent of buds in other cultivars. This high level in Grenadier was reached in a Kent orchard; and in the Wisbech Area some trees were almost bare of spur buds, and wood buds failed to break normally. In April 1961, bud rot was prevalent in several Norfolk orchards, being especially severe in Grenadier but also present in Bramley's Seedling.

Five years or so before the period of this review, **Bitter Rot** (*Pezicula malicorticis* (Jackson) Nannfeldt, stat. conid. *Gloeosporium perennans* Zeller & Childs; and rather less commonly *Pezicula alba* Guthrie, stat. conid. *G. album* Osterw.) was not a problem to the English fruit-grower, but with storage of fruit for longer periods it became one of the most serious sources of loss.

In the 1958 crop, losses were less than might have been expected in

view of the wet conditions. Several high losses (40-60 per cent) occurred in Essex. In the south-east, bitter rot was more widespread and severe than usual particularly on cv. Cox's Orange Pippin and, in the south-west it appeared earlier than ever and was common in later storage. *Gloeosporium fructigenum* Berk., the imperfect stage of *Glomerella cingulata* (Stonem.) Spauld. & Schrenk, was noted in Glos. In 1960 bitter rot was common in the Eastern Region and some losses were heavy: 10-15 per cent losses were quite common in Suffolk for example, with isolated losses of up to 60 per cent. It was more damaging than usual in the West Midland and South-eastern Regions.

Not a lot was reported in 1957, 1959 and 1961. Although partly a seasonal matter, some of the reduction in incidence, in Eastern counties for example, could also be attributed to careful selection of orchards from which fruit was stored, early marketing from orchards known to have a bad record and to late sprays of captan. In Essex, losses in the 1957 crop were well below those in the previous 4-5 seasons: a few instances of 5-10 per cent loss were reported but the majority were of 0-2 per cent loss whereas in the previous season, for example, losses were of the order of 10 per cent in many orchards with one or two very severe outbreaks.

The increased significance of bitter rot had prompted studies of the development of the disease and means of controlling it. Several workers investigated *G. perennans*. Edney (*Ann. appl. Biol.* 1958, **46,** 622-9) studied development of this fungus in the orchard and in store, Corke (*J. hort. Sci.* 1959, **34,** 85-95) the infection of pruning wounds, and Sharples (ibid. 72-84) the response of apple stems to wound infection. Sharples (*Rep. agric. hort. Res. Stn Univ. Bristol, 1957,* 105-14) also discussed the orchard sources of *Gloeosporium* spp. and means of reducing them, and established that mummified fruitlets and leaf scars could harbour the fungi (*Pl. Path.* 1959, **8,** 71-2). Spores of *G. album* were found to be dispersed throughout the year with a peak period in autumn (Burchill and Edney, *Rep. E. Malling Res. Stn, 1960,* 90-3). Montgomery (*Nature, Lond.* 1958, **182,** 737-8) suggested important differences in the biology and mode of parasitism of *G. album* and *G. perennans* and studied storage conditions in relation to the rots (*Rep. E. Malling Res. Stn, 1958,* 140-1). Sharples (*Rep. agric. hort. Res. Stn Univ. Bristol, 1958,* 125-7) compared the morphology of shoot infections of *G. perennans* and *Nectria galligena.* Guthrie (*Trans. Br. mycol. Soc.* 1959, **42,** 502-6) recorded the perfect states of *G. album* and *G. perennans,* that is *Pezicula alba* and *P. malicorticis* respectively, in England. The perfect state of *G. album* was previously unknown and was described and named by Guthrie, but that of *G. perennans* was known at that time in U.S.A. and the Netherlands and was recorded by Guthrie at Horsmondon, Kent. Sharples (ibid. 507-12) also made observations on the perfect state of *G. perennans* and discussed the possible importance of the apothecia. Corke (*Rep. agric. hort. Res. Stn Univ. Bristol, 1958,* 118-24) studied the effect of cover crops on the susceptibility of cv. Cox's Orange Pippin apples to infection with *G. perennans:* he found a possible correlation between rate of rotting and the level of nitrogen in the tree.

Fungicidal sprays on trees in late summer were found to reduce *Gloeosporium* rots in storage (Marsh, Montgomery and Edney (*Pl. Path.* 1957, **6,** 39-41), and Moore and Edney (*Rep. E. Malling Res. Stn, 1958,* 106-9)

1. Globe artichoke heads bearing lesions attributed to *Ascochyta hortorum* var. *compositarum* (p. 232).

2. Horseradish root cut to show internal discoloration of unknown cause (p. 91).

PLATE V

Blueberry shoot showing witches' broom effect caused by the rust *Pucciniastrum goeppertianum* (p. 148). A normal shoot is on the left.

PLATE VI

investigated timing of spray treatments. Hey, Hunnam and Bryant (*Grower*, 1961, **56**, 114-6) reported on a trial of forecasting infection of Cox's Orange Pippin in store. Sharples and Somers (*Pl. Path.* 1959, **8**, 8-12) obtained reduced sporulation from wood lesions with phenyl mercury compounds applied in late winter but Edney *et al.* (ibid. 1961, **10**, 10-3) obtained variable results in respect of storage rots with sprays applied to trees in winter. Spencer and Wilkinson (*Nature, Lond.* 1958, **181**, 1603-4; *Pl. Path.* 1960, **9**, 49-51) markedly reduced rotting by chemically treating the atmosphere in stores.

Brown Rot (*Sclerotinia fructigena* Aderh. & Ruhl.) was most prominent in 1959. In 1958 it was heavy locally, for example in Essex and Suffolk and, in August, around Evesham: in the South-eastern Region it was widespread and developed rapidly. It was common elsewhere that year but not severe. In 1957 the South-eastern Region and the Evesham Area had widespread attacks, but in 1960 and 1961 outbreaks were generally slight apart from local trouble in some eastern counties: as in the other years, bird and weather damage often preceded development. Byrde (*Pl. Path.* 1959, **8**, 90-3) found that when griseofulvin was applied to cv. Laxton's Superb trees a significant reduction in infection of fruit injuries by *S. fructigena* followed. He also examined the nature of resistance to brown rot in some cultivars of cider apple (*J. hort. Sci.* 1957, **32**, 227-38). Byrde, Fielding and Williams (in *Phenolics in plants in health and disease*, 1960, pp. 95-99 ed. J. B. Pridham, Oxford: Pergamon Press) discussed the role of oxidized polyphenols in the varietal resistance of apples to this disease, summing up recent advances in this aspect.

In 1958, **Dry Eye Rot** (*Botrytis cinerea* Fr.) was noticeable in the Eastern Region, especially on cv. Laxton's Superb; in Suffolk, where the rot was widespread and generally above average, it was very severe on cvs. Cox's Orange Pippin and Lord Lambourne but less so on Worcester Pearmain. In the same year, the rot was widespread on a range of dessert cultivars in the Evesham Area. In the South-western Region, **Eye Rot** (*Nectria galligena* Bres.) was apparently more serious than usual in 1958, and in orchards where *Nectria* canker was common in 1961 eye rot of fruits was usually prevalent. An unusual feature in the South-eastern Region was the occurrence in 1957 of **Black Rot** (*Physalospora obtusa* (Schw.) Cooke) on fruit before picking in a number of orchards especially of cv. Worcester Pearmain. Other reports of dry eye rot, eye rot and black rot were few.

In 1961, approximately five per cent of cv. Monarch fruit in a cold store in Worcs, maintained at 1·5-3°C, were affected by **Phytophthora Fruit Rot** (*Phytophthora syringae* (Kleb.) Kleb.). The apples, which were from a grassed-down orchard, went into store wet, and some boxes had stood for a few days in the orchard before being taken into the store.

Fruit Rot (*Pleospora pomorum* Horne) is rarely reported in stored apples. This fungus, which may be identical with *P. herbarum* (see Moore, *Br. Parasitic Fungi*, p. 287), was isolated at the South-eastern Regional Centre from specimens received from Efford, Hants in September 1959. A fungus with pycnidia and spores similar to those of *Phoma mali* Schulz & Sacc., the causal agent of **Phoma Rot** of apple, was associated with the rotting of a single fruit in Hants in 1957. According to Moore (ibid. p. 246) the disease had not been specifically recorded from Britain.

Blue Mould (*Penicillium expansum* S. F. Gray) was sometimes troublesome: in stores examined in Essex in 1961 this was among the commonest causes of loss. An Evesham grower reported it to be the most common cause of loss in cv. Monarch. This organism, with *Botrytis cinerea* was used in studies on resistance of apples to fungal invasion (*Res. exp. Rec. Minist. Agric. Nth. Ire. 1958*, **8,** 183-4; *1959*, **9,** 216-7; *1960*, **10,** 267-8). *Rhizopus* sp. and *Trichothecium roseum* (Pers.) Fr. were also responsible for rots: the latter was noted on scab lesions in a Som garden in 1960.

A wet 1958 brought reports of **Sooty Blotch** (*Gloeodes pomigena* (Schw.) Colby), particularly from the West Midland and Eastern Regions. In some Suffolk orchards it was bad enough to prompt attempts at removal with bleaching powder. In Essex it could not usually be easily removed. In 1960, the trouble was present in many Hants orchards and occasional elsewhere. A species of *Fusarium* caused severe spotting on apples covered with straw on a concrete floor in Som in 1957: where straw had not been used the condition was absent.

At the end of June 1959, black scattered spots were noticed on a number of apples on a few trees in a Kent orchard. At first sight they resembled scab lesions but proved to be patches of mycelium of *Cladosporium herbarum* (Pers.) S. F. Gray with some spores present. Below the patches the epidermis was slightly sunken and discoloured, but no development in the flesh was seen. Possibly the fungus had established itself on drops of 'honeydew' on the fruits. This kind of spotting has been seen before on a few occasions on fruits suspected of infection by scab. *C. herbarum* is known as an occasional cause of apple rot in store in this country and elsewhere: while often secondary, it has been shown to be capable of direct infection. No doubt, *Cladosporium* appears at times on injured apples on trees, as reported from Worcs in 1955. Some years ago *C. herbarum* was said to have caused considerable losses in an orchard in Czechoslovakia and to have occurred in one or two other orchards there (Smolák, *Ann. Acad. tchécosl. Agric.* 1948, **21,** 48-53 (*Rev. appl. Mycol.* 1950, **29,** 30)): a spotting, apparently similar to that in Kent, was seen, but a black film of hyphae and tufts of conidia sometimes covered the whole fruit. The Czechoslovakian records were claimed to be the first of the fungus occurring on apples on trees.

Fireblight (*Erwinia amylovora* (Burr.) Winslow *et al.*) was confirmed in single trees in two private gardens in the Southern area of Essex in 1960 and 1961 respectively. These were the only outbreaks in apple recorded up to the end of 1961, although the disease was building up on pear (see p. 125) and ornamental hosts since its first discovery in the country in 1957.

Cole (*Ann. appl. Biol.* 1959, **47,** 601-11) found that two bacteria isolated from a rotted apple produced actively spreading rots when inoculated into cv. Bramley's Seedling apples: one was *Pseudomonas melophthora* Allen & Riker and the other he named *Ps. pomi*.

Symptoms of **Star Crack** (apple star crack virus) were noted in many parts of the country (Yorks and Lancs, West Midlands, Eastern, South-eastern and South-western Regions and N. Wales). This fruit condition had first been recorded by Jenkins and Storey (*Pl. Path.* 1955, **4,** 50-2) in a number of East Anglian orchards. The virus nature of star crack, which they had suggested, was confirmed by Posnette and Cropley (*J. hort. Sci.* 1959, **34,** 126-9) in graft-transmissions. **Mosaic** (apple mosaic virus)was

more conspicuous than usual in the West Midland Region in 1961. In field trials, two strains of this virus reduced yield of mature Cox's Orange Pippin and Allington Pippin trees by about 30 per cent over four years while yield of Worcester Pearmain and Newton Wonder was only slightly reduced (Posnette and Cropley, *Rep. E. Malling Res. Stn, 1958*, 89-91): it was noteworthy that the mild strain caused inconspicuous or no symptoms in most apple cultivars. **Chat Fruit** (apple chat fruit virus) was noted by advisers in several west Midland orchards of cv. Lord Lambourne. It was established that chat fruit was graft-transmissible and caused by a virus (Luckwill, *Rep. agric. hort. Res. Stn Univ. Bristol, 1957*, 56-9).

Apple **Rubbery Wood** virus, known to be common but symptomless in many dessert apple cultivars and rootstocks but particularly affecting cv. Lord Lambourne, was found to be susceptible to inactivation by heat treatment (Posnette, Cropley and Wolfswinkel, *Rep. E. Malling Res. Stn, 1961*, 94-6). The virus has been found in cider cultivars (Campbell and Williams, *Rep. agric. hort. Res. Stn Univ. Bristol, 1958*, 64-7). In inoculation experiments, Campbell (*J. hort. Sci.* 1961, **36,** 268-73) found the MI clonal rootstock to be more affected than MVII but the rigidity of neither to be affected.

Apples often carry viruses without showing obvious symptoms (Luckwill, *Tidsskr. PlAvl*, 1961, **65,** 133-7). Campbell (*Rep. agric. hort. Res. Stn Univ. Bristol. 1960*, 51-5) studied the distribution of latent viruses in clonal rootstocks and in dessert, culinary and cider cultivars, while Posnette and Cropley (*J. hort. Sci.* 1961, **36,** 168-73) tested a range of Malling and Malling-Merton apple rootstocks and three scion cultivars for latent infection, by using five indicator hosts. Attention was drawn by Luckwill and Campbell (ibid. 1959, **34,** 248-52) to the value of *Malus platycarpa* as an indicator for latent viruses. They observed line pattern, dwarfing and scaly bark symptoms on young *M. platycarpa* inoculated with buds from commercial apple cultivars and rootstocks. The viruses responsible for these symptoms were apparently widely distributed in latent form in commercial apple cultivars and clonal rootstocks but were thought to be harmless. Campbell (*Rep. agric. hort. Res. Stn Univ. Bristol. 1961*, 73-6) discussed experiments with heat treatment to inactive apple chlorotic leafspot, platycarpa scaly bark and platycarpa dwarfing viruses. Campbell and Coles (ibid. *1961*, 71-3) examined the time factor in transmission of these last three viruses and of mosaic. **Chlorotic Leafspot** (apple chlorotic leafspot virus) was known to be of very wide occurrence in commercial cultivars and to be present in many clonal rootstocks. Apple **Flat Limb** virus also occurs in this country.

Information on other, minor, virus diseases of apple which had been found in Britain will be found in *Virus Diseases of Apples and Pears*, 1963, Ed. A. F. Posnette, Technical Communication No. 30, Farnham Royal: Commonwealth Agricultural Bureaux.

The worst year for **Bitter Pit** (non-parasitic) was 1959; it was then unusually common in many areas perhaps owing to the particularly dry season. Some attacks in the east were very severe. In Norfolk, mainly large fruits were affected, and on individual branches rather than whole trees. Some serious outbreaks developed in Essex in 1961 and the condition was also particularly prevalent in other eastern and southern counties.

Bitter pit was prominent in the east in 1957. Apart from in 1960, when prevalence was less in most areas, the South-eastern Region had prominent amounts in all years. Studies on the nature of the disease were made in Northern Ireland (*Res. exp. Rec. Minist. Agric. Nth. Ire. 1958-60*, **8**, (2) 184-5; **9** (2), 217-9; **10** (2), 268-9). **Sun Scald** of fruit was another consequence of the hot dry summer of 1959 and occurred widely. In Berks, incidence was marked on cv. Bramley's Seedling and to a lesser extent on dessert cultivars. Prominent rich brown blisters were seen on cvs. Laxton's Superb and Bramley's Seedling from an orchard in Herts where 34°C in the shade had been recorded. **Superficial Scald** was severe in many samples coming out of store in Norfolk early in 1961; up to 20 per cent being affected in some instances. Smith found that raising the temperature during storage seemed a possible method of controlling this trouble (*Nature, Lond.* 1959, **183,** 760). **Russetting** was prevalent in the 1958 crop in the Evesham Area, while **Cracking** of fruit, often with russetting, was fairly general on Cox's Orange Pippin and other cultivars in several eastern counties in 1958. Cracking was prevalent in Glos in 1961. Montgomery discussed some of the causes of russetting and cracking of Cox's Orange Pippin (*Rep. E. Malling Res. Stn, 1958*, 163-4). **Internal Breakdown** was particularly prevalent in 1959 in the south-west; and in Oxon in Cox's Orange Pippin in 1960, fruits being larger that season. **Glassiness** (Water Core) appeared to be quite common in Devon in 1960, and **Core Flush** was quite severe in gas-stored Cox's Orange Pippin marketed in February and March 1961 in Hants. **Lenticel Spotting** was noted. **Frost Injury** to fruits, producing rings round the calyx end, or collapse of fruitlets at the calyx end, was another trouble recorded. An unusual type of frost injury was noted in a store in the south-east: the fruit showed a one-sided appearance as with incomplete pollination. The under-developed side of the fruit was unblemished externally but a light-brown necrosis in irregular arc-like patterns was present in the flesh.

Papery Bark (non-parasitic) developed in several eastern areas in 1959 and was thought to be associated with the summer drought. In 1960 it was widespread and severe on older cv. Bramley's Seedling trees in Suffolk; and affected many orchards in the east and south-east, sometimes badly. Poorly drained or, alternatively, shallow and light soils were involved in these and other outbreaks. The extreme wet of 1958, followed by the drought of 1959 had left many trees in poor condition. In the 1961 season collapse of foliage after blossoming, or failure of buds, were serious problems in some areas and attributed to waterlogged soils. **Hail Injury** was very severe in scattered orchards in Essex in 1957, and in July and August 1960, in parts of the west Midlands. The characteristic lenticular cankers on young wood were also noted elsewhere. The effect of severe **Wind Injury** on the leaves of apple rootstocks was investigated by Barlow and Hancock (*Rep. E. Malling Res. Stn, 1957*, 96-100). Considerable **Frost Injury** in spring, in some susceptible orchards, was mentioned in reports. **Cox Spot** was very prevalent and often severe in many parts of the country in 1958 and 1961: a similar condition was noted on a number of cultivars other than Cox's Orange Pippin, for example Merton Worcester. Certain genetical disorders which produce symptoms similar to those caused by viruses are known to occur in apples in England (see Posnette and Cropley,

Virus Diseases of Apples and Pears, 1963, *Tech. Comm.* No. 30, pp. 81-5, Farnham Royal: Commonwealth Agricultural Bureaux).

Mineral deficiency problems did not feature in reports. Foliar sprays of magnesium compounds were found to be useful for control of the familiar **Magnesium Deficiency,** in experiments made by Ford (*Rep. E. Malling Res. Stn, 1957*, 106-12) and by Greenham and White (*J. hort. Sci.* 1959, **34,** 238-47). Colhoun, McElroy and Ward (*Pl. Path.* 1961. **10,** 116-8) recorded a form of damage, which they found to be associated with the use of Western red cedar in the storage boxes, occurring in cv. Bramley's Seedling apples in commercial storage in Northern Ireland.

Pear

Fireblight, the outstanding problem during the period, is discussed on p. 125.

Scab (*Venturia pirina* Aderh.) was of little consequence in 1957, 1960 and 1961. In 1958 it was noticeable in the Eastern Region wherever insufficient spraying was done; in Norfolk most orchards of cv. Laxton's Superb were affected, some severely. Scab was locally severe in Hants that year. In 1959, in the Evesham Area, this disease was at a higher level on fruit and leaves than for some years. In Cambs it occurred particularly on fruit, notably of Laxton's Superb, and in June it appeared on leaves and fruits of this cultivar in Norfolk at a time when other cultivars appeared to be free. Kirkham (*J. gen. Microbiol.* 1957, **16,** 360-73) found no major difference in nutritional requirement between *V. pirina* and *V. inequalis* nor between isolates differing in pathogenicity etc. He examined the significance of polyphenolic metabolites in nutrition and host relations of *V. pirina* (*J. gen. Microbiol.* 1957, **17,** 120-34; ibid. 491-504). Scab resistance in progenies of cultivars was studied at the John Innes Institute (Brown, *Euphytica*, 1960, **9,** 247-53). The influence of season, and timing and concentration of sprays, on a phytotoxic effect experienced with phenylmercuric chloride was investigated by Kirby and Bennett (*Rep. E. Malling Res. Stn, 1957*, 148-151). Wheatley (*Rep. agric. hort. Res. Stn Univ. Bristol, 1957*, 97-104) tentatively compared the germination and growth of conidia of *V. pirina* and *V. inequalis*, and Kerr (*Trans. Br. mycol. Soc.* 1961, **44,** 465-86) described centrum development in the formation of the fruit bodies of the two species.

In 1959, **Canker** (*Nectria galligena* Bres.) was more prevalent and severe than usual in the west Midlands and was widespread in the South-eastern Region. In both areas the fireblight survey may have discovered more outbreaks than would have been noted normally. Some of the many reports in this and other years were of severe infection, for example almost every tree in 8½ acres of 9-year-old trees of cvs. Conference and Bristol Cross had at least one canker, Conference being the worse affected. Many moderately important attacks were found in Norfolk in 1961—a 2½-acre orchard had to be grubbed because of severe canker. Reports of this fungus causing **Eye Rot** came mainly in 1958, and from Worcs and War, but no extensive infections were found. The outbreaks of **Powdery Mildew** (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) did not appear to be of any importance. Wood infection was mentioned in a few reports, and in one Worcs orchard

of cv. Doyenné du Comice infection led to russetting and cracking of the fruits. Foulds (*Grower*, 1957, **48**, 579) was unable to detect overwintering on shoots of Doyenné du Comice which had been infected the previous season.

Blossom Wilt (*Sclerotinia laxa* Aderh. & Ruhl.) has been considered uncommon and confined to cv. Fertility (Moore, *Br. Parasitic Fungi*, p. 340). In 1959, infected specimens of another cultivar, Conference, were examined at Evesham. The disease was observed a few times in Wales and Kent, and spur blight was also noted in Wales. There was more **Brown Rot** (*Sclerotinia fructigena* Aderh. & Ruhl.) than usual in the Evesham Area in 1958, and considerably more in 1959. In 1958, *Sclerotinia* spp. causing brown rot were common on Clapps Favourite and other early cultivars in Worcs, and in 1959 were worse than usual in the Eastern Region; in both areas following damage by birds and wasps.

In *Pl. Path.* 1957, **6**, 95, Groom and Hall recorded **Bitter Rot** (Pezicula malicorticis (Jacks.) Nannf. syn. *Gloeosporium perennans* Zeller & Childs) as occurring on samples of cv. Conference fruit received from orchards in Essex, Worcs and Cambs. These were the first records of *G. perennans* on pear in this country. A few stored Conference fruits were affected in a Kent store in 1959. *P. alba* Guthrie (*G. album* Osterw.) was recorded only in 1958, from Cambs. **Die-back** and **Stem Canker,** associated with *G. perennans*, was severe on dying trees in an orchard in Ches; in most instances infection had apparently started below ties made from nitro-chalk bags. Groom and Hall (loc. cit.) also recorded this fungus on wood, in Kent and Essex.

Bark Canker (*Phacidiella discolor* (Mouton & Sacc.) Potebn.) was present in a few Kent orchards. In one instance, in cv. Doyenné du Comice, it was said to occur only on those trees overshadowed by high walls and trees in an adjacent garden. In an Essex orchard, branches of cv. Fertility were killed while cvs. Conference and Laxton's Superb were unaffected. However, Laxton's Superb was affected in another outbreak in the south-east. **Surface Canker** (*Pezicula corticola* Nannf.) was noted on a single tree in Dorset. Known on apple, this fungus appeared not to have been previously recorded on pear. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), previously rare in pear, was seen in individual orchards in Herefs, Sussex, Hants and Cards. The Hants outbreak was at Efford E.H.S. where 3-year-old trees were trimmed-back in March 1960 and the cut surfaces not painted. Of 450 cv. Conference trees, 160 were lost, but only a few Doyenné du Comice and Williams' Bon Chrétien were affected: an association with different pruning dates was suspected.

A number of outbreaks of **Sooty Blotch** (*Gloeodes pomigena* (Schw.) Colby) were encountered in Cambs and Suffolk in the wet summer of 1958. Two crops in Worcs developed **Botrytis Rot** (*Botrytis cinerea* Fr.) following damage by birds and wasps respectively, and **Phytophthora Fruit Rot** (*Phytophthora cactorum* (Leb. & Cohn) Schroet.) was determined on cv. Doyenné du Comice in Devon in 1960.

The comparatively rare **Leaf Blister** (*Taphrina bullata* (Berk. & Br.) Tul.) was unusually common in the South-eastern Region in 1960 and 1961, numerous outbreaks being seen. **Rust** (*Gymnosporangium fuscum* DC.) was identified on leaves from Northumb in 1957. **Root Rot** (associated with

Roesleria pallida Sacc.) has been recorded frequently in the past on dead pear trees. An example in Hants in 1960 was due primarily to death of roots by waterlogging. Quite a number of attacks by **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were diagnosed in this host. *Verticillium dahliae* Kleb. was isolated from discoloured 1-year-old wood in the rootstocks of a few poorly growing trees in Hants in 1959. This fungus has previously been recorded on quince rootstocks to which pears are grafted (Wormald and Harris, *Gdnrs' Chron.* 1933, **93,** 192-3).

The detection of **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) in Kentish pear orchards in the late summer and autumn of 1957 (Crosse, Bennett and Garrett, *Nature, Lond.* 1958, **182,** 1530) caused the gravest concern not only to this country, but also to the rest of Europe as this was regarded as the first authentic record for the whole continent. Despite eradication measures, infection spread both within Kent and out to other parts of the country. Two-thirds of the dessert pear acreage is in Kent mostly between the north downs and the Thames Estuary. During 1958-61 fireblight was eradicated from Worcs and Wisbech; it was being held back in N.W. Kent, and also in Southend where there had been serious outbreaks in rosaceous hosts as well as in pear. However, the disease gained a hold in ornamental hosts in London from where it has since proved impossible to eradicate it.

R. A. Lelliott discussed the development of fireblight in England, and the eradication campaign, in detail at an international conference on the disease at Canterbury in August 1967. The following account, relevant to the years of this review, is taken verbatim from Lelliott's contribution to the report of that Conference (EPPO Publications, 1968, Ser. A. No. 45-E, 10-14).

'In the autumn of 1958, surveys of pear orchards throughout England indicated that fireblight was confined to 3 areas of Kent; 15 pear orchards were affected (Lelliott, 1959). The Fire Blight Disease Order dated November 6, 1958 gave, *inter alia*, powers to grub and burn infected trees and to prevent the movement of plant material from, and bee hives from or to, affected orchards. By the end of the year all of the trees known to be affected (approximately 2600) were destroyed. One affected orchard was found later that year in Worcestershire, but the action taken appears to have been successful because no further infection has been found in the W. Midlands since then. Surveys were made in early 1959 of orchards in the affected areas of Kent and in the summer they were extended to cover the whole of Kent. These largely confirmed the results of the 1958 surveys, but towards the end of the season scattered infection was found in shrubs and street-lining trees in the south-east and south suburbs of London, and in the conurbation centred on Southend-on-Sea in Essex; Southend lies across the Thames Estuary from the Cooling Peninsula, one of the affected areas in Kent. The policy of destroying infected trees, and inspection of orchards in affected areas at 7-14 day intervals, was successful in eliminating infection in most orchards, and by the end of 1959 the Maidstone area of Kent appeared to have been cleared and in the other two areas affected orchards were being freed from infection faster than other orchards were becoming infected. But in the densely built-up areas of London and its suburbs the disease was very difficult to locate and continued to build up

on susceptible shrubs in private gardens and public parks. Very intensive efforts were made to prevent the disease spreading from Southend to a belt of top fruit that extends across Essex and which, at its nearest point, is 10 miles (about 16 km) north of the town. In the summer of 1960, all known pear orchards in Kent (9248 acres or about 3700 ha) were inspected at least once and orchards in the affected areas at least twice; the infected orchards were inspected at approximately weekly intervals and neighbouring orchards somewhat less frequently. In the Southend area all private gardens (about 50000), public parks and some 200 miles (300 km) of streets were inspected a number of times; a belt about 6 miles (10 km) deep around the urban area was also searched. These efforts appeared to have restricted the spread in Kent and Essex markedly, but the disease appeared at Wisbech, 90 miles (145 km) to the north of the nearest known outbreak, and in 3 shrub nurseries in the Bagshot area of Surrey. In urban and suburban London the disease appeared to be spreading unchecked.

Because of the practical impossibility of eliminating infection in London it was decided in 1961 that the policy of eradication from the country must be abandoned and the effort should be concentrated on containing spread through the fruit areas by destroying all infected trees. Between 1958 and 1960, 9620 infected trees had been destroyed. Over 90 per cent of the 6281 pears were of the variety Laxton's Superb—a prolific producer of secondary blossom which was widely planted as a pollinator for Conference. It was noteworthy that although fireblight was common in scrub hawthorns, it was only rarely found in the hawthorn hedges surrounding orchards; these hedges are usually clipped and produce little blossom'.

The lack of infection, mentioned by Lelliott, in orchard hawthorn hedges was confined only to these early years.

Lelliott (*loc. cit.*) pointed out that spread in pears during the spring has been unimportant in England and that conditions suitable for epidemic spread during the main blossoming appear not to have occurred in Kent during these or later years. Infection has been most severe in cultivars, notably Laxton's Superb, which produce secondary blossom later in summer when conditions are much more favourable to the bacterium.

Other reports of the early stages of the epidemic were given by Crosse (*C. P. News*, 1959, **5**, 4-5), Lelliott (*Agriculture, Lond.* 1959, **65**, 564-8) and (in Southend) Hodgkin and Fletcher (*N.A.A.S. q. Rev.* 1965, No. 67, 106-10).

Various aspects were studied by Crosse, Bennett and Garrett (*Ann. appl. Biol*, 1960, **48**, 541-8) including seasonal development, symptoms etc.

Billing described an association between capsulation and phage sensitivity in *E. amylovora* (*Nature, Lond.* 1960, **186**, 819-20), the characteristics of English isolates of the bacterium (*J. appl. Bact.* 1961, **24**, 195-211) and, with Crosse and Garrett, recommended a procedure for the expeditious diagnosis of fireblight and bacterial blossom blight in the laboratory (*Pl. Path.* 1960, **9**, 19-25).

Other hosts of fireblight were recorded by Billing, Fletcher, Glasscock, Elis Jones and Lelliott (*Pl. Path.* 1959, **8**, 152).

Nowhere mentioned in reports for 1957 and 1958, **Bacterial Blossom Blight** (*Pseudomonas syringae* van Hall) sprang into prominence in those for 1959 because of the interest in fireblight. Frequently the trouble could

be linked with damage by late frosts. In 1959 a great number of reports came from throughout the Midlands, the east and south-east, the cultivar Conference particularly suffering. Death of branches with canker, originally suspected as fireblight, appeared to be caused by *Ps. syringae.* In 1960, reports again came from the east Midlands, the east and south-east, but only occasional orchards in the Evesham Area were affected. A feature of this year was the death of branches following infection with *Ps. syringae.* Cankers up to 3 feet long were seen, apparently originating from infected blossom trusses. The bacterium was isolated readily from the lesions and appeared to be the primary pathogen. Although this type of injury was already familiar in the U.S.A., it had not then been generally recognized in this country; in spite of observations for a few years prior to 1959 which suggested that it might occur frequently. Blossom blight was slight but general following late frosts in the Evesham Area in 1961 but was scarcely noted from elsewhere. A procedure for diagnosing bacterial blossom blight and fireblight in the laboratory was described by Billing, Crosse and Garrett (*Pl. Path.* 1960, 19-25).

Stony Pit (pear stony pit virus), the most familiar of the virus diseases of pear was mentioned in reports from the west Midlands, south-east and other areas. In an orchard of mixed cultivars at Evesham, symptoms closely resembling those of stony pit were prevalent in 1959 but, in this instance, capsid damage was thought to have resulted in the pitting. Posnette (*J. hort. Sci.* 1957, **32,** 53-61) showed that virus diseases of pear, other than stony pit, were prevalent in clones in commercial use. The effect of these in stunting plants of some cultivars seemed considerable. He described the symptoms of **Ring Pattern Mosaic** (apple chlorotic leafspot virus), **Vein Yellows and Red Mottle** (pear vein yellows virus), and also referred to **Quince Sooty Ring Spot** virus which develops in quince but was found to be latent in pear. The latter virus in combination with apple chlorotic leafspot virus is now thought to be responsible for **Quince Stunt** which Posnette (*loc. cit.*) referred to as being latent in pear. Vein yellows is frequently seen on many cultivars, occurring most commonly in nurseries. Posnette and Cropley (ibid. 1958, **33,** 289-91), investigating quince clones as indicators for viruses latent in pear, identified one virus (quince yellow blotch virus), apparently rare in England, causing **Yellow Blotch** in cv. Packham's Triumph; and another (pear bark necrosis virus), widespread in the material indexed, causing **Bark Necrosis** in several cultivars including Clapp's Favourite, Beurré Hardy and Williams' Bon Chrétien. These workers and Wolfswinkel succeeded in inactivating vein yellows and bark necrosis viruses in pear buds and young-shoot tips on growing plants by heat, and in raising healthy plants from these tissues (*Rep. E. Malling Res. Stn, 1961,* 94-6). Cropley showed a bark canker disease of Williams' Bon Chrétien to be graft transmissible and named it **Blister Canker** (pear blister canker virus) (ibid. *1959,* 104). **Apple Rubbery Wood** virus has been found in dessert and perry pears (Campbell, *J. hort. Sci.* 1961, **36,** 268-73).

Russetting affected most fruits in Herefs in 1958. **Frost Injury** to blossoms, which occurred in the Midlands in several years, has already been mentioned under bacterial blossom blight (p. 126). A reddening of the leaves, somewhat resembling peach leaf curl and due to frost injury, was found at Bristol in 1960. **Wind Injury** had affected a number of specimens

examined in the East Midland Region in 1961: the symptoms had followed severe gales on 8/9 May and low humidities. Frost, wind and spray injury were said by Rogers and Booth (*Rep. E. Malling Res. Stn, 1958*, 143-7) to be major factors in irregular cropping of pear. The very hot dry conditions in 1959 led to **Heat Scorch** in cv. Conference in the Eastern Region in July and August: at first sight the condition resembled fireblight. The drought that year and the following wet winter appeared to be associated with a **Die-back** ascribed to soil conditions and seen on several orchards in the south-west in 1960. **Rosetting,** of importance in nurseries in the south (cf. Williams and Campbell, *Rep. agric. hort. Res. Stn Univ. Bristol. 1956*, 51-6), affected 12 per cent of 300 cv. Conference trees in Ches in 1957. **Internal Breakdown** of fruit in store sometimes caused concern. Symptoms resembling star cracking, which in apples is known to be caused caused by a virus (p. 120), were present on fruits of cv. Marguerite Marillat (or a closely related cultivar) in an orchard of mixed cultivars near Chesham.

Plum

Still a big problem in plum growing areas, **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was particularly noticeable in 1959, and to some extent in 1961, in the west Midlands, east and south-east. In the Evesham Area in 1959 drought undoubtedly accentuated the symptoms. In an informal survey of orchards in Hunts, Cambs and I. of Ely that year it was found to be widespread and often serious especially on cv. Victoria. It had been hoped to combat silver leaf by injecting antifungal chemicals into the stems of plum trees, and work on this at East Malling has been carried out by Bennett (*Ann. appl. Biol.* 1962, **50,** 515-24). However, the need for chemicals more effective than the ones she tried became apparent. This worker also had evidence that isolates from different hosts can vary in their pathogenicity to plum (*J. hort. Sci.* 1962, **37,** 235-8), thus giving clues as to how important are sources of infection outside plum orchards.

There was more **Brown Rot** (*Sclerotinia fructigena* Aderh. & Ruhl. and *S. laxa* Aderh. & Ruhl.), and it was more severe than for some seasons, in Worcs in 1958 and 1959 but it was not serious. The amount of damage by birds and wasps meant worse attacks than usual in the east in 1959. A few attacks in War in 1960 followed hail damage. *S. laxa* was responsible for the **Blossom Wilt and Wither Tip** which developed in many districts around Evesham in 1957. In 1958, **Rust** (*Tranzschelia pruni-spinosae* Pers. Diet.* was prevalent in the west Midlands and south-east at the end of the summer, causing a great deal of defoliation in some orchards particularly of cv. Victoria: in the Evesham Area it had appeared unusually early. By September, premature leaf fall was severe in some Norfolk orchards. Defoliation was considerable in an orchard in Cornwall in 1960 and pycnidia of the hyperparasite *Darluca filum* Cast. were found on the rust pustules in October. At Wisley, Green and Brooks (*Jl R. hort. Soc.* 1959, **84,** 528-30) found this to be the most common rust recorded in 1959. Both **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) and **Fomes Heart Rot** (*Fomes pomaceus* (S. F. Gray) Bigeard & Guill.) were

* see *C.M.I. Descriptions of Pathogenic Fungi and Bacteria* 1971, Nos. 287 and 288 for differentiation of varieties of *T. pruni-spinosae* on *Prunus*.

found now and again but, apparently, **Powdery Mildew** (*Podosphaera oxyacanthae* DC. de Bary var. *tridactyla* (Wallr.) Salm.) caused very little trouble as it was rarely reported on. **Pocket Plums** (*Taphrina pruni* (Fuckel) Tul.) was prevalent in N. Wales in 1957.

In 1959, 25 of the trees in a 40-acre orchard of cv. Yellow Egg plums in Kent bore dead and dying branches, the cortex and vascular cylinder next to the cambium being discoloured brown. Infection by **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was confirmed in one of the affected trees. Keyworth (*Rep. E. Malling Res. Stn, 1943*, 52-4) had found verticillium wilt in Kent some years ago, *V. alboatrum* being isolated from a wilted cv. Victoria tree which had apparently contracted infection from wilted hop bines placed around the base of the tree 11 months before. Of the record on Yellow Egg it was said that no hops or hop products had been on this land for at least 50 years.

Bacterial Canker (*Pseudomonas morsprunorum* Wormald) received little comment. It was above normal in the east in 1959 and was bad in some orchards there in 1961. Shot hole was prevalent in all cultivars in the Vale of Evesham in 1960. Wormald and other workers at East Malling had earlier exploited the greater resistance of some cultivars, by working popular, but more susceptible, ones such as Victoria onto them. A resistant cultivar forms the stem and crotch of the tree onto which the susceptible cultivar is grafted. In trials with this method in the west Midlands, Schofield and Clift (*Pl. Path.* 1959, **8**, 115-20) showed the value of Myrobalan B as a stock for top-working, though it has disadvantages in other respects. These authors pointed out that, due to its popularity, Victoria had been widely planted in the previous 20 or 30 years or so: as young plum trees are much more likely to be killed by bacterial canker than older ones, say those over 12 years old, advisers in Worcs and other parts of the west Midlands have frequently had cases of death of the young trees brought to their attention in recent years. An emulsion paint containing streptomycin, used on the stems of young Victoria trees, reduced the amount of stem canker developing in a trial in Scotland done by Boyd and Paton (*Pl. Path.* 1958, **7**, 88-91). Crosse and Garrett (*Nature, Lond.* 1961, **192**, 379-80) were able to differentiate the strains of *Ps. morsprunorum* from plum and cherry by phage typing, while Crosse and Hingorani (*Nature, Lond.* 1958, **181**, 60-1) described a method for isolating the bacterium from the soil in plum and other stone-fruit orchards.

Fortunately, the virus disease **Prune Dwarf** (prune dwarf virus), important in some countries, is not common in Britain. In susceptible cultivars growth can be badly checked but in some cultivars it causes no symptoms. Plum leaf roll is caused by this virus.

Plum pox-like symptoms had been seen in orchards here for a number of years but it was not until 1959 that the virus nature of the English disease was first confirmed at East Malling Research Station; in 1960, fruit symptoms developed on trees of cv. Warwickshire Drooper inoculated with material from two sources (see station annual reports). Posnette and Ellenberger (*Pl. Path.* 1963, **12**, 115-7) concluded that this **Pseudo-pox** disease was distinct from the plum pox (Sharka) prevalent in the Balkans and later spreading in Europe (see also Part II, p. 258).

Rough cankered and deeply split bark, symptoms rather similar to those

caused when *Ps. morsprunorum* attacks repeatedly, can be due to infection by a virus. An account of this disease, **Bark Split** (plum bark split virus), which was formerly probably confused with bacterial canker, has been given by Posnette and Ellenberger (*Ann. appl. Biol.* 1957, **45**, 573-9). It had been confirmed in several plum cultivars in England but seemed to be relatively innocuous except in a few such as Cambridge Gage. Some cultivars in which the virus is prevalent are not noticeably cankered; most trees on common plum rootstocks are infected. Though symptoms were widespread in a plantation in Worcs in 1958 the trees were growing vigorously. Posnette and his colleague compared bark split symptoms with those of diamond canker of French prune in California. They have also written on the prevalent **Plum Line Pattern** (*Ann. appl. Biol.* 1957, **45**, 74-80), suggesting that plum line pattern and apple mosaic are caused by strains of one virus (apple mosaic virus is now referred to as a strain of prunus necrotic ring spot virus). Plum trees with no symptoms have often been proved to carry the virus but some cultivars are prominently marked. These workers reported that of 40 plum cultivars they tested, 19 were infected. The vigour of some cultivars is gradually reduced, but on the whole the effects of the virus seem relatively mild. Ellenberger (*Rep. E. Malling Res. Stn, 1959*, 99-101) has demonstrated that plum material can be freed from bark split, line pattern and apple chlorotic leafspot (peach green mottle) viruses by heat treatment.

Some years ago Posnette (ibid. *1952*, 182-3) described the effects of one or two other viruses and some virus-like symptoms. An upward rolling of the leaves, with a wilted appearance to the tree is caused by a virus which he thought might be the one causing peach yellows in the U.S.A. A veinlet clearing virus was transmitted by grafting in 1952 from trees of two gage cultivars, Denniston's Superb and Kirke's Blue, to Myrobalan seedlings, the leaves of which became mottled and the plants very stunted.

Shot Hole (prunus necrotic ring spot virus) causes vigour loss in some cultivars including rootstock clones Brompton, common plum and Marianna, while **Plum Stunt** is a virus disease in which small, powdery brown pustules develop on the young shoots (see *Rep. agric. hort. Res. Stn Univ. Bristol, 1949*, 80-1). Certain abnormalities encountered such as leaf variegations, leaf narrowing or oak-leaf effects, and translucent spots which eventually result in shot holes are bud sports and are not due to viruses.

Leaf Rolling, of unknown cause but probably related to climatic conditions, was seen in three plantations of cv. Marjories' Seedling at various places in Worcs in 1960. All the trees showed pronounced leaf rolling, and the crispness of the foliage resulted in rattling when shoots were shaken. Older leaves were most affected. Individual leaves showed a marginal chlorosis which became interveinal in some instances. The trouble was not considered by East Malling Research Station to be due to virus and analyses of leaf tissue gave no guide to the cause.

Cherry

Silver Leaf (*Stereum purpureum* (Fr.) Fr.) continued to be troublesome in some orchards: symptoms were commonly seen in the Evesham Area in 1959 particularly in cv. Napoleon. **Brown Rot** (*Sclerotinia fructigena* Aderh. & Ruhl. and *S. laxa* Aderh. & Ruhl.) was well above average in this

Area in 1958, but **Blossom Wilt** (*S. laxa*) was apparently not serious at any time except in one Norfolk orchard. Very nearly every plantation observed in 1959 in the Evesham Area had some **Witches' Brooms and Leaf Curl** (*Taphrina cerasi* (Fuckel) Sadeb.), frequently on a high proportion of the trees. Forty-four of 82 selected plantations, mainly old or half-derelict, surveyed for little cherry in N.W. Worcs in July 1968, had *Taphrina* but, usually, infected trees were few. There were other enquiries from the west Midlands and Kent, and an attack on flowering cherry was seen in Beds. **Scab** (*Venturia cerasi* Aderh.) was not prominent, and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was present in a few orchards. Not seen in Britain on this host since 1909, **White Root Rot** (*Rosellinia necatrix* Prill.) was found in 1960 by Dr. R. J. W. Byrde on MMIII rootstocks from a nursery in Devon.

Bacterial Canker (*Pseudomonas morsprunorum* Wormald), a major problem in cherry cultivation, was recorded in 77 out of 82 plantations in a N.A.A.S. survey for little cherry in N.W. Worcs in July 1968. The orchards had been selected because of their age and, often, neglected state and were not typical of the area. Canker was frequently bad in them but usually in a single cultivar or a few trees only. The significance of pruned shoots as a site of infection was illustrated in 1958 when about 50 trees were killed among 600 12/1 cherry rootstocks planted in March 1955 in Kent. The trees had been pruned in July 1958: 600 trees from the same delivery, planted elsewhere, were not killed.

Crosse (*Ann. appl. Biol.* 1957, **45,** 19-35), studying leaf-scar infection, found incidence to be greatly affected by time of inoculation, and incidence and severity to increase with concentration of inoculum. The importance of bacterial populations on leaf surfaces as a source of infection in autumn prompted Crosse (ibid. 1959, **47,** 306-17) to devise a method for measuring this inoculum potential. Crosse and Shanmuganathan (*Rep. E. Malling Res. Stn, 1960,* 87-9) compared the virulence of strains of *Ps. morsprunorum* obtained from leaf surfaces of sprayed and unsprayed cherry trees.

Crosse and Hingorani (*Nature, Lond.* 1958, **181,** 60-1) described a technique for isolating phages for *Ps. morsprunorum* from soil, and found them to be plentiful in soil beneath affected cherry trees. Phage typing enabled Crosse and Garrett (ibid. 1961, **192,** 379-80) to differentiate strains of the bacterium isolated from cherry and plum.

Experiments on control by spraying at East Malling over many years were reviewed by Moore, Crosse and Bennett (*Rep. E. Malling Res. Stn, 1958,* 96-102): no material had proved more successful than Bordeaux mixture. In the same report (pp. 93-5), the latter two authors reported on the incorporation of cotton seed oil, with sprays of Bordeaux mixture, to lessen the chances of early defoliation. Interest was shown in streptomycin as a spray for control of the disease, and Crosse (*Ann. appl. Biol.* 1957, **45,** 226-8 and *Pl. Path.* 1957, **6,** 31-5) reported on trials. This worker, with Garrett (ibid. 1958, **46,** 310-20) investigated the systemic capabilities of the antibiotic.

Work on the genetics of bacterial canker progressed at the John Innes Horticultural Institution and a programme of breeding for resistance has been carried on by Matthews (see annual reports for 1959-61).

The lack of conspicuous symptoms with most of the cherry tree viruses in

many cultivars meant that the effect of these viruses on growth and cropping was for long overlooked. In fact, cherries of all our top fruits are the most affected by viruses. Posnette and Cropley (*Rep. E. Malling Res. Stn*, *1959*, 92-5) found such viruses in over 90 per cent of the apparently healthy cherry trees examined in England, and estimated a probable annual reduction in potential crop of at least 20 per cent. They reported on crop reduction caused by **Necrotic Line Pattern** (cherry mottle leaf virus), **Tatter Leaf** (prunus necrotic ring spot virus), **Rusty Mottle** (cherry rusty mottle virus) and **Rugose Mosaic** (cherry rugose mosaic virus—a strain of prunus necrotic ring spot). Cherry **Ring Mottle** virus affects many sweet cherry cultivars according to these authors (*J. hort. Sci.* 1956, **31,** 298-302).

Rusty mottle was found to be prevalent in sweet cherry trees in England (Posnette and Cropley, *Rep. E. Malling Res. Stn*, *1960*, 85-6). These authors regarded the disease as distinct from the mild rusty mottle disease in N. America, and found no relationship between it and necrotic ring spot or other *Prunus* viruses.

A report of **Little Cherry** (cherry little cherry virus), in an orchard in Worcs, was the first for Europe (Posnette and Cropley, ibid. *1957*, 122-3). Prior to this the disease had been reported only from N. America. Cropley (*Nature, Lond.* 1960, **188,** 875-6) identified **Leaf Roll** (cherry leaf roll virus) in eight orchards in Kent and one in Worcs, and gave an account of this virus disease in *Ann. appl. Biol.* 1961, **49,** 524-9. In the past there has probably been some confusion between leaf roll and bacterial canker. In Cropley's opinion the virus was responsible for decline and death of many trees in several orchards and field observations suggested that many others were affected. The virus was confirmed in Berks during this period by East Malling Research Station. English cherry trees with **Rasp Leaf** have been found to contain either raspberry ring spot or arabis mosaic viruses (Cadman, *Virology*, 1960, **11,** 653-4). Cropley (*Ann. appl. Biol.* 1961, **49,** 530-4) found this disease in 17 orchards in England: his transmission tests indicated that raspberry ring spot virus is the cause of this disease in most English orchards but that arabis mosaic virus can cause similar symptoms. Also recorded during this period (Posnette and Cropley, *Pl. Path.* 1957, **6,** 85-7) was the graft-transmissible, severe canker on cv. Frogmore, found in an orchard at Ledbury, Herefs and referred to as **Frogmore Virus Canker** (cherry necrotic rusty mottle virus). A necrotic ring spot-sour cherry yellows (prune dwarf virus) complex was recorded in the annual reports of East Malling Research Station.

The effect of latent virus infection on growth and yield of sweet cherry trees was discussed by Posnette and Cropley at a European symposium (*Tiddskr. PlAvl*, 1961, **65,** 118-24) at which Cropley (ibid. 1961, **65,** 91-5) also gave details of some viruses transmitted by sap inoculation from cherry trees with European rasp leaf and leaf roll viruses.

In 1959, a large proportion of 1958-growth on the lower branches in a Bucks plantation of cv. Early Rivers was affected by **Tan Disease** (non-parasitic). This cultivar is particularly susceptible to the condition, in which the outer bark of one-year twigs peels to reveal a rust-like powder. In this instance the trees were on the site of a long-term manurial trial but there appeared to be no differences in the damage within the various treatments.

Peach and Nectarine

Leaf Curl (*Taphrina deformans* (Berk.) Tul.) was particularly common and severe on peach in many parts of the country in 1957: it was noted also on nectarine. Exceptional prevalence and severity was recorded for Worcs and War in 1958, and heavy attacks developed in parts of east and south-east England in the same year. Locally severe infections were recorded in other years too. **Powdery Mildew** (*Sphaerotheca pannosa* (Wallr.) Lév. var. *persicae* Woronich.) was observed on a number of occasions in western districts, and **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was reported on both peach and nectarine. Infection of the current year's shoots by the **Blossom Wilt and Brown Rot** organism (*Sclerotinia laxa* Aderh. & Ruhl.) had resulted in small cankers at the bases of the leaves in an orchard in Salop visited in April 1957. **Canker** and **Die-back** in a number of trees in an orchard in the south-east in 1957 were associated with a species of *Cytospora;* attack by *Cytospora* on peaches was referred to in 1923 by Cayley (*Ann. appl. Biol.* **10,** 253-75 (p. 257)). **Shot-hole** of leaves, examined in Salop in 1959, was associated with a species of *Hormodendron.* Also recorded were **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer), **Bacterial Canker** (*Pseudomonas morsprunorum* Wormald), **Line Pattern** (prunus necrotic ring spot virus) and **Lime-induced Chlorosis.** Harrison (*Nature, Lond.* 1957, **180,** 1055-6) showed that beet ring spot virus is soil-borne to peach, and discussed a possible relationship between this virus and peach yellow bud mosaic in California.

Almond

Leaf Curl (*Taphrina deformans* (Berk.) Tul.) was commonly reported from some areas in 1957—a year when it was particularly abundant on peach; numerous enquiries were received in spring that year in the south-east. Affected almond trees were seen in other years too. The only other disease of almond mentioned was **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

Medlar

Leaf Blotch (*Sclerotinia mespili* Schellenb.) was confirmed in Berks causing extensive damage to a medlar tree.

Fig

Mosaic, caused by the fig mosaic virus, was noted in Norfolk, and alone represented the fig diseases in advisers' reports.

Walnut

Few diseases of walnut were encountered by advisers. The common **Blotch** (*Gnomonia leptostyla* (Fr.) Ces. & de Not.) did not pass unnoticed, and many trees in a plantation in Sussex were affected in 1961. Reports of

Armillaria Root Rot (*Armillaria mellea* (Fr.) Kummer) came from Derby, Oxon and Surrey and **Bacterial Blight** (*Xanthomonas juglandis* (Pierce) Dowson) from Som.

Cob Nut

A devastating attack of **Bud Rot and Twig-canker,** in a Kent plantation was drawn to the attention of East Malling Research Station in 1955. Moore (*Pl. Path.* 1961, **10,** 167) ascertained that a species of *Gloeosporium*, differing (Moore, *J. hort. Sci.* 1963, **38,** 109-18) from *G. coryli* (Desm.) Sacc., was responsible. It was the first recorded outbreak in this country though Moore presumed the fungus to have been present in plantations over a long period. He records that the disease was also found on wild hazel in several hedgerows and, sometimes to an epidemic extent, on other holdings in Kent.

Nut Rot (*Sclerotinia fructigena* Aderh. & Ruhl.), already familiar in plantations in Kent, was noted in Berks following weevil damage, and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found in two plantations in Kent.

Quince

Powdery Mildew (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) was occasionally found. In 1957, **Verticillium Wilt** (*Verticillium alboatrum* Reinke & Berth.) was confirmed in quince A stocks in a nursery in Glos; this appeared to be a new host record for the country (recorded in Moore, *Br. Parasitic Fungi*, p. 421). Posnette (*J. hort. Sci.* 1957, **32,** 53-61) discussed **Quince Veinbanding** virus, and referred to **Quince Stunt** virus (now thought to be a complex), which does not usually cause leaf symptoms in quince C rootstocks or in pears. The latter virus was found in all of 40 plants of quince C rootstocks collected from different parts of England (Posnette, Cropley and Wolfswinkel, *Rep. E. Malling Res. Stn, 1961*, 94-6). Quince C rootstocks, free from stunt virus were propagated by Posnette from tissues on plants which had been grown at 37°C. Posnette (*loc. cit.*) also reported on a new symptom type on quince seedlings, called **Sooty Ring Spot;** this virus (quince sooty ring spot virus) is latent in pear.

Grape Vine

The most common trouble was **Powdery Mildew** (*Uncinula necator* (Schw.) Burr.); and **Grey Mould** (*Botrytis cinerea* Fr.) was noted also. In January 1959, berries of cv. Colmar in several glasshouses on a nursery in Bucks showed extensive **Penicillium Rot** (*Penicillium expansum* S. F. Gray). Other cultivars in other houses were unaffected. Severity was linked with the date the houses were 'started' into growth: the latest started, and hence the most rapidly growing vines, being worst affected. Although some berries had been cracked, the trouble seemed essentially one of uninjured berries. Rapid growth and adverse weather were thought to have been

largely involved. **Shanking** of berries, a condition associated with malnutrition, was noted; as also was **Sun Scald, Fruit Splitting,** and injury by hormone weedkillers, for example in one case when roots extended beyond the glasshouse and under a treated lawn.

Melon

About 70 per cent of *Cucumis melo* L. cv. Tiger plants in a commercial garden in Herts wilted and died in August 1956 and 1957. The cause was found by Buxton (*Pl. Path.* 1959, **8,** 96-7) to be **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *melonis* Snyder & Hansen). The fungus had not been identified in this country previously though a wilt attributed to a species of *Fusarium* had been reported several times from southern and eastern counties (Moore, *Bull. Minist. Agric. Fish.* No. 126, 1944, p. 73). Fusarium wilt was recorded in the South-western Region in 1957. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was found in Sussex in 1957, and in 1960 in Kent, and had not been recorded on this host previously, and wilt (*Verticillium* sp.) was newly recorded in the South-western Region and was noted in a few crops there and elsewhere in 1961. **Bacterial Soft Rot** was the only other disease reported.

Black Currant

As commented on by Schofield (*Agriculture, Lond.* 1960, **67,** 250-2), premature defoliation or partial defoliation had recently become a common sight in west Midland currant plantations, especially in Herefs and W. Worcs. This and shrivelling of fruit before picking resulting from occasional very early leaf fall could most commonly be attributed to **Leaf Spot** (*Pseudopeziza ribis* Kleb.). An increased acreage of currants had led to increased prominence of leaf spot and interest in possible control by spraying (*loc. cit.*).

In the Evesham Area, the earliest detection of leaf spot was recorded each year; in 1957, just prior to picking; 1958, mid-June; 1959, 20 May; 1960, 4 July; 1961, 18 May—by which time some defoliation had already occurred.

In 1957, infection was late but severe in much of the Evesham Area, causing marked defoliation in some districts, and in unsprayed crops in Essex and Suffolk. Above normal amounts occurred in the East Midland and Eastern Regions in 1958, for example in Norfolk leaves dropped in July and by September bushes were bare but for a few leaves at the shoot tips. Considerable defoliation by August took place in Herefs and Worcs. Following early attacks in these two counties in 1959, infection developed slowly but by picking or soon after it was severe in very many plantations, and by late August about 50 per cent of most plantations of cvs. Baldwin and Wellington XXX over two years old and west of the Malverns, were already defoliated. Development was slow in the Evesham Area in 1960 in spite of the wet August. By now many growers were spraying against leaf spot. In the Eastern Region that year the disease was worse than usual: in some Norfolk plantations 100 per cent defoliation occurred after picking.

In 1961, infection was general around Evesham by July though rarely causing defoliation: in the east and south-west it appeared early but dry weather and zineb sprays generally prevented severe defoliation. Corke was investigating fungicides for control (*Rep. agric. hort. Res. Stn Univ. Bristol, 1959*, 118-22) and found captan generally less effective than zineb (ibid. *1961*, 144-53). Corke and Wilson (ibid. *1960*, 115-9) found differences the susceptibility of cultivars to infection.

Rust (*Cronartium ribicola* J. C. Fischer) was more serious than normal in the South-eastern Region, and became widespread in Herefs and Worcs, in 1958. Very few other severe attacks were seen, though the rust was sometimes locally troublesome in mid-Wales. The cultivar Westwick Choice was especially affected in E. Suffolk in 1958. Some attacks of **American Mildew** (*Sphaerotheca mors-uvae* (Schw.) Berk. & Curt.) were severe locally in Cambs in 1960. A number of other outbreaks were encountered in each year and the mildew was occasionally extensive in plantings. In a plot at Harpenden infection was severe in June 1961 on bushes of cv. Wellington XXX and present on cv. Baldwin, having spread from nearby gooseberries. **European Mildew** (*Microsphaera grossulariae* (Wallr.) Lév.) was on two crops in the south-west in 1957 but not otherwise noted. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was recorded on single bushes from a few localities only, but **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) affected a number of plantations, nearly all in the south-east. Extensive **Die-back** (*Botrytis cinerea* Fr.) of young shoots occurred in February to March, 1957, on plantations in various parts of the East Midland Region. The trouble was thought to be associated with failure of wood to mature properly in the previous autumn. During 1958, many plantations of cv. Baldwin in Herefs had dead shoot tips where *Botrytis* had apparently infected through the buds: it was difficult to account for the amount of die-back in a mild season though frosts were late and severe. *Botrytis* was associated with many instances of shoot death in May, in Suffolk and Norfolk in 1958. In Norfolk, infection by this fungus on green berries by mid-June of the same year lead to much shrivelling and 'running-off' and up to a quarter of many crops were lost. By July, fruit loss, heavy in places, had been experienced in the majority of Norfolk plantations, cv. Westwick Choice being particularly badly affected.

Previously, **Violet Root Rot** (*Helicobasidium purpureum* Pat.) had been recorded but rarely on black currant: a single young bush was affected in a new plantation in Lincs in 1958 and the perfect stage was present on a stool received from Suffolk in 1960. On the latter, the fungus was purely superficial. In 1959, **White Root Rot** (*Rosellinia necatrix* (Hartig) Prill.) was confirmed in a patch of young plants in Suffolk, the perfect stage developing on one plant.

Reversion (black currant reversion virus) is extremely common and several heavy attacks were reported, notably in Norfolk. **Vein Pattern** is caused by a strain of the reversion virus and was noted in a few plantations in Lincs, Herefs and Som. **Variegation** (black currant variegation virus) —yellow variegation and vein-banding—occurs in several cultivars of black currant and is prevalent in cv. Daniel's September Black (Ellenberger, *Rep. E. Malling Res. Stn, 1961*, 101). The condition was seen in nearly all of 200 two-year-old bushes of this cultivar in Som in 1961.

Fertilizer Injury due to excessive applications was thought to be more common in the west Midlands than formerly realized. Concentrate fertilizers applied around the base of bushes caused prevalent damage in May 1958 in Herefs and Worcs, and the condition was seen again in 1959. Surface roots had died and vascular tissue was discoloured. An example of **Fasciation** (non-parasitic) was noted in Wales.

Red Currant

Leaf Spot (*Pseudopeziza ribis* Kleb.) was noted in the west Midlands, **American Mildew** (*Sphaerotheca mors-uvae* (Schw.) Berk. & Curt.) in Hants; and **Rust** (*Cronartium ribicola* J. C. Fischer) was slight in some Norfolk plantations in 1958. **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) was heavy in a Norfolk crop in 1958, and was again seen in Norfolk in 1960 where clearwing moth attacks had been severe.

Gooseberry

Outside the gooseberry growing areas of the west Midlands and East Anglia, incidence of **American Gooseberry Mildew** (*Sphaerotheca mors-uvae* (Schw.) Berk. & Curt.) was not unusual except in the Northern Region and parts of the east Midlands, where infection was above normal in June 1957 and in 1960 respectively. It was, however, locally severe in the Yorks and Lancs Region in 1957, and severe in 1961 in plantations under trees in Glos though not above average in open situations.

In 1957, mildew was more severe than usual in War in May, and also in East Anglia causing some concern later in the season. Some outbreaks were severe in the west Midlands in 1958 and infection was moderate to heavy generally in Herts and Hunts, and appreciable in some Norfolk plantations. Herefs and Worcs had above-average intensity of mildew in 1959, and Worcs and War in June 1960. In 1959 infection was prominent in Norfolk and it was fairly extensive in bushes growing under pears. In 1960 the disease was widespread and often severe in many parts of the Eastern Region. In 1961, development was rapid on all cultivars in the Evesham Area after the end of April resulting in some severe outbreaks, and attacks in I. of Ely were occasionally heavy. Pilot observations by Taylor and Schofield (*Pl. Path.* 1957, **6**, 88-90) indicated the effectiveness of dinocap in controlling mildew, and confirmed the value of washing soda/soft soap.

The much less harmful **European Gooseberry Mildew** (*Microsphaera grossulariae* (Wallr.) Lév.) made no appearance in the records and was presumably of no consequence. **Cluster Cup Rust** (*Puccinia caricina* DC. var. *pringsheimiana* (Kleb.) Henderson) was noted in most years in Wales, but was not severe: incidence was however above normal in N. Wales in 1961. Outside Wales very few attacks of rust were noted; these were in Lancs, Worcs and Salop in 1957 and 1958. Widespread **Leaf Spot** (*Pseudopeziza ribis* Kleb.) in the I. of Ely in 1957 caused early defoliation, and some severe outbreaks in E. Suffolk in 1958 involved whole plantations. In September 1958 the disease was reported to be denuding bushes on several Norfolk

plantations, and in 1959 was more than usually prevalent and intense in the Evesham Area. A number of other outbreaks were recorded during these years, most of them severe and involving defoliation. In Sussex all plants were affected in 5 acres of cv. Leveller in July 1957. The common **Die-back** (*Botrytis cinerea* Fr.) was noted; and die-back, often with associated *Botrytis* continued to be a problem in the Evesham Area principally in cv. Leveller. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found in a number of plantations, while bushes thought to be affected with **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) were seen in Norfolk and I. of Ely in 1959. Of four acres of mature cv. Leveller bushes in a Worcs plantation 10 per cent showed die-back associated with **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.). Pycnidia of a *Phoma* sp. were present on some of the lesions which were thought to have resulted from gale damage on a Devon nursery in 1958.

Veinbanding (gooseberry veinbanding virus) was undoubtedly very common in gooseberry stocks and was known to have caused some serious damage in the last few years at least. Virus diseases of gooseberry have so far received little attention and there may be others, with less striking effects, which are of importance. Symptoms agreeing with those of **Hawthorn Leaf,** a serious breakdown of gooseberries, described in Scotland (*Gdnrs' Chron.* 1956, **140,** 403) were noted in a private garden in the west Midlands in 1959: the cause of these symptoms was still unknown. There were several instances of **Waterlogging** (non-parasitic) affecting plantations in the Eastern Region, Worcs and Herefs in 1961—on a Norfolk holding 250 cv. Careless plants were killed.

Strawberry

The Red Core Disease of Strawberry Plants Order 1957 replaced the earlier order of 1952. These orders have attempted to restrict the spread of **Red Core** (*Phytophthora fragariae* Hickman) by making it illegal to sell strawberry runners from land declared to be infested. By the end of 1956, notices had been served on over 500 commercial and non-commercial premises declaring specified land to be infested. By the end of 1961 the number had risen to about 640 and by now the disease had been confirmed in most of the main strawberry growing areas of the country. An exception was the Cheddar area of Som.

Outbreaks discovered around Wisbech in East Anglia shortly before the period of this review may have been due to an introduction, and further local spread, of infected planting material. In 1958 red core was confirmed for the first time on silt soils in Holland (Lincs) and I. of Ely. Many failures were reported from North Wales in the 1950's, and during a small survey in 1957 in the Holt Area of Denbigh, eight new outbreaks were recorded. The first record for Anglesey was made in 1958.

The wettest year, 1958, brought the most new outbreaks and the most severe attacks. The fewest outbreaks were in 1960 though the disease was then severe in S. Hants. The Eastern Region again had above average attacks in 1961.

Particularly worrying during the period was the confirmation of red core

in some cv. Merton Princess elite stocks in Ches and Essex and at Trawscoed, and at the site in Kent where these stocks had originated. The cultivar Huxley was also affected. The Kent site was abandoned for the raising of strawberries and the stocks were destroyed.

Because of its susceptibility, cv. Mme Lefebvre had declined in popularity in the Tamar Valley in Cornwall to be superseded by the then resistant cv. Cambridge Prizewinner. However, in 1958, this resistance began to break down. The field resistance of cv. Cambridge Vigour had been good in the South-eastern Region but in 1959 the disease showed up very markedly in the field perhaps as a result of the very wet conditions the previous autumn and in early spring. Many infected crops of this cultivar made a good recovery the following year.

Breeding and selection for resistance to red core by Reid and his colleagues, and studies of physiologic races of the fungus, new sources and inheritance of immunity, by Montgomerie, continued at the Scottish Horticultural Research Institute, Dundee (see annual reports for 1957-61 inclusive). The difficulties of attaining total immunity led to a changing emphasis towards field tolerance. The nutritional needs of three physiologic races of *P. fragariae* were investigated by Davies (*Trans. Br. mycol. Soc.* 1959, **42**, 193-200) and the growth of isolates in the presence of various polyphenols by Jarvis (ibid. 1961, **44**, 357-64).

In reports of **Verticillium Wilt,** the disease has almost entirely been attributed to, or the fungus said to be confirmed as, *Verticillium dahliae* Kleb., no matter what the Region. There were a few enquiries each year from the Eastern Region and it was occasionally serious there. It was sometimes prominent during crop inspections in Norfolk. Wilt is common also in the south-east. Serious losses were caused in some crops in the South-eastern Region both in 1958 and 1959, but in 1961 it was rather late and less frequent there than usual. The disease often featured in reports from Kent and Sussex. The several reports from the Starcross Sub-Region, including two of severe attack, were apparently the first from this area, and wilt was again present, in several first-year crops, in 1961. Outside the above areas, records were few, but were scattered from north to south including Wales.

V. alboatrum Reinke & Berth. was specified but rarely; i.e. once in Devon in 1959 and, for the first time for several years, it was isolated from strawberry plants in the South-eastern Region in 1960 (until this time *V. dahliae* had consistently and exclusively been isolated from affected plants in Hants). In the Wye Sub-Region, *V. alboatrum* was, as in the past, never found to be associated with the wilt.

Cambridge Vigour and Cambridge Favourite were among the popular cultivars commonly attacked by this wilt; but in one year when they were again commonly mentioned in reports from the Wye Sub-Region, Royal Sovereign, though widely grown there, was noticeably absent from the wilt records. Tolerance to verticillium wilt in strawberry was investigated by Talboys, Bennett and Wilson (*Rep. E. Malling Res. Stn, 1960*, 94-9); these authors found *V. alboatrum* to be more pathogenic to this host than the more prevalent *V. dahliae.*

Powdery Mildew (*Sphaerotheca macularis* (Fr.) Lind) received scant mention in reports from north of the Midlands and from Wales throughout the five years. Crops in much of the Evesham Area and the Eastern Region

were severely affected every year except 1961: in the former area it was widespread and severe each season by mid-summer while, in the east, Norfolk alone appeared to be particularly affected in 1957 but several counties in the next three seasons. In the south-east, mildew was of consequence only in 1960, when it was general and more than usually severe on cvs. Cambridge Rival and Cambridge Vigour in August. In the south-west, some trouble was experienced in Som in 1957, 1959 and 1961 and in the Starcross Sub-Region in 1959 attacks were often heavy under cloches and became severe on outdoor crops after picking. The general picture over the period, then, was of mainly local trouble in 1959 and 1961 but of general and often severe infection in much of the strawberry crop in the other years. Cultivars particularly affected when others in the same area were less so, or free from infection, were Cambridge Vigour, Cambridge Rearguard, Cambridge Favourite, Royal Sovereign and Coronation. Huxley, Talisman and Redgauntlet were variable in their behaviour, while Merton Princess crops were free in Norfolk in 1958 when several other cultivars were severely affected. According to Till (*Pl. Path.* 1958, **7**, 30-1) powdery mildew had assumed such severity on Royal Sovereign as to threaten the continued production of this cultivar on some holdings in the Cheddar area of Som. Both he (*loc. cit.*) and, elsewhere, Ingram, Schofield and Taylor (ibid. 1957, **6**, 63-4) conducted fungicide trials in which dinocap in particular gave good control. Peries (ibid. 1961, **10**, 65-6) was able to establish the survival of *S. macularis* in green overwintering leaves but not in any other way. The first known occurrence of the perithecial stage on strawberry was in June 1959, in a glasshouse at Bristol (Khan, ibid. 1960, **9**, 18); perithecia eventually developed on peduncles, pedicels, sepals and mildewed stolons.

Grey Mould (*Botrytis cinerea* Fr.) caused some very heavy losses in the wet summer of 1958 in several parts of the Midlands, the Eastern Region and S. Wales. In Worcs and War, and in Herts, fruit losses of up to 40 and 50 per cent respectively were experienced. Very little mention was made of the disease during 1957, 1959 and 1961, but in 1960 there were a few moderate losses in parts of the west Midlands, and grey mould was very prominent in much of S. Wales and general in N. Hants. The autecology of *B. cinerea*, control with fungicides and susceptibility of cultivars were studied by Jarvis (see the annual reports of the Scottish Horticultural Research Institute for 1957-61 incl.). Khan (*Rep. agric. hort. Res. Stn Univ. Bristol, 1959*, 123-6) obtained significant control with griseofulvin and dinocap. Control measures against *Botrytis* were summarized by Moore (*Rep. E. Malling Res. Stn, 1960*, 132-3).

Leaf Scorch (*Diplocarpon earlianum* (Ell. & Everh.) Wolf) caused extensive spotting in one or two crops only: reports were few. **Leaf Blotch** (*Gnomonia fructicola* (Arnaud) Fall.) was severe in a few crops in Kent, and noted once or twice in the Eastern Region, in 1960 and 1961: in one Kent crop, over half of a 4-acre crop of cv. Redgauntlet was affected. It was especially common in mid-Wales in 1960. A number of crops were badly attacked by **Leaf Spot** (*Mycosphaerella fragariae* (Tul.) Lindau). In Norfolk in 1957 this disease was thought to be on the increase, one grower reporting that half an acre of certified stock had to be discarded. Most of a field of maiden cv. Royal Sovereign plants was affected in Kent in March 1960,

and in this year it was especially plentiful in mid-Wales. Leaf spotting similar to this disease was prevalent in the Cheddar area of Som in November 1961, especially on cv. Cambridge Favourite but the fungus, if present, failed to fructify when incubated; spots were also common on the stems. The uncommon **Leaf Spot** (*Stagonospora fragariae* Briard. & Har.) was noted only in the Eastern Region where it was confirmed on cv. Royal Sovereign in Norfolk, and occasionally noted on Huxley, in 1958.

Dale (*Pl. Path.* 1961, **10,** 124-5) reported substantial loss in 1958 to ½ acre crop of Baron Solemacher perpetual strawberries in Kent, caused by a **Downy Mildew.** The fungus appeared to be *Peronospora fragariae* Roze & Cornu, of which there was a British collection with similar spore measurements in the herbarium of the Commonwealth Mycological Institute. There was no recurrence on the crop in 1959 and 1960. Berries, sepals and leaves were affected in 1958, and fruits on affected plants had failed to develop.

Armillaria Root Rot (*Armillaria mellea* (Fr.) Kummer) affected plants on a few holdings in the south-east and elsewhere. In Hants in 1960, the *Rhizoctonia solani* stage of *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was isolated from rotting buds and petioles of forced plants in pots, and this fungus was present on the rotting crown of a plant from another site in Hants. In 1958, widespread loss in ½ acre of strawberries in Som was caused by **White Root Rot** (*Rosellinia necatrix* Prill.). This disease also caused collapse of one-year-old plants in Cornwall in 1960.

A **Crown Rot,** from which *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. developed copiously, occurred on cv. Baron Solemacher perpetual strawberries on a holding in Kent in 1958. The plants were raised from seed under glass in spring and planted out in May; unthrifty plants had been noted in some boxes prior to planting out. Wilting occurred in the field. Other *Phytophthora* spp. have previously been recorded causing wilting or crown rot of strawberry. A similar crown rot involving *Phytophthora* sp. attacked patches of plants on a Kent holding in 1960 too, and damping-off causing gaps affected about a dozen boxes of plants in Kent in 1960—in both cases Baron Solemacher perpetual strawberries were the host. In 1961, a crown rot due to *Phytophthora cactorum* (Leb. & Cohn) Schroet. was noted in Hants, and over 80 per cent of 3 acres of Baron Solemacher strawberries in Kent were dead by the end of May following wilting, browning of the roots and rotting of the crown. Chloropicrin and metham-sodium markedly reduced the amount of infection in a later planting of this cultivar on the site, and nabam gave a good measure of control. *Pythium* sp. was associated with stunted growth in a strawberry crop in Denbigh, but the trouble was primarily one of establishment in a wet winter.

Leafy Gall (Cauliflower Disease) (*Corynebacterium fascians* (Tilf.) Dowson) was noted twice in the west Midlands in 1957 and in Cornwall in 1961: all three outbreaks were on the popular cv. Cambridge Favourite.

Of the aphid-transmitted viruses, **Severe Crinkle** (mixed infection with strawberry crinkle and strawberry mottle viruses) received most mention in reports but was referred to as severe in a few crops only. Symptoms of **Yellow Edge** (mixed infection with strawberry mild yellow edge virus with mottle virus or occasionally crinkle virus) were quoted as slight in the

main, while **Mild Crinkle** (infection with mottle and vein chlorosis (a strain of strawberry crinkle) virus) was seldom referred to. Posnette and Cropley (*J. hort. Sci.* 1958, **33,** 282-8) freed plants from mottle virus by heat treatment but found crinkle and yellow edge viruses more difficult to eliminate. Posnette and Jha (*Rep. E. Malling Res. Stn, 1959,* 98) freed some plants from crinkle virus and probably also from vein chlorosis virus by use of cuttings and heat treatment. Improved growth and quality of stocks in this country at about this period could be attributed to the growing by runner producers of stocks freed from crinkle and yellow edge at East Malling, and more recently made available by the Nuclear Stocks Association. The spread of the aphid-borne viruses was being investigated at East Malling (annual reports of the Research Station for 1958 to 1960 inclusive). Cropley (*Rep. E. Malling Res. Stn, 1957,* 124-5) found a leaf grafting technique to be unreliable for transmitting viruses in this group from commercial cultivars to *Fragaria vesca.*

Though probably present in strawberry crops, the leafhopper-transmitted **Green Petal** (clover phyllody virus) remained unrecognized until 1951. It was increasing in importance throughout the south-west in 1957, especially in runner production, and throughout much of the country in 1958. The Eastern and South-Eastern Regions again reported widespread attack in 1959 but there appeared to be less in the south-west. The disease was newly recorded in the Yorks and Lancs Region in 1960 when infection was discovered in two crops in Yorks, but although quite a lot was seen in Norfolk, green petal seemed to be less prominent in 1960 and was certainly less so in 1961 when hardly any reports were received. The cultivar outstandingly affected during these years was Cambridge Favourite. Frazier and Posnette (*Ann. appl. Biol.* 1957, **45,** 580-8) studied the transmission and host range of this virus. They distinguished two components of 'green petal': green petal caused by the virus responsible for clover phyllody (p. 67) and bronze leaf wilt caused by clover witches' broom virus.

Of the soil-borne viruses, **Arabis Mosaic** virus (AMV) became recognized as the one of particular significance on strawberry in England and Wales. Harrison (*Ann. appl. Biol.* 1958, **46,** 221-9) first isolated the virus, which he referred to as raspberry yellow dwarf virus, from strawberry: it was later shown that raspberry yellow dwarf was a strain of AMV (Cadman, *Virology,* 1960, **11,** 653-64). In Scotland, most outbreaks of viruses in this group were found to be caused mainly by raspberry ring spot virus (RRV) or the beet ring spot strain of tomato black ring virus. In England and Wales, although these two latter viruses were being shown to be not uncommon on other hosts they seemed to be of little significance on strawberry.

Soil-borne viruses began to receive attention in the 1950's but had almost certainly been present long before. Their effects may have been obscured by the aphid-borne viruses before stocks freed from these were in wide use. The main concern of the soil-borne viruses is in certified runner production.

The first big flush of reports of AMV from the N.A.A.S. came in 1959. By 1961 the disease had been confirmed in the West Midland and Eastern Regions, Wales and throughout the south. The nematode vector *Xiphinema diversicaudatum* Micol. was often confirmed in soil from round affected plants.

A short survey for AMV was made by the N.A.A.S. in the Cheddar area of Som in 1959. Where runners of cv. Cambridge Favourite were brought in in the autumn from a supplier in Wilts known to have an infected stock, at least 40 per cent was infected and the crop was very poor. On other holdings infection of "Cambridge" cultivars varied from 0·2 to 6 per cent. Runner beds of Cambridge Favourite at Cheddar appeared to be clean or had less than one per cent of AMV.

On a farm in the Starcross Sub-Region, on which both the virus and the eelworm had been found in a strawberry crop, a neighbouring field which had been in ley for about eight years (following strawberries) was examined by the N.A.A.S. Entomology Department and at least 55 nematodes of a *Xiphinema* sp. were found in 250 g of soil. Some wild white clover plants on this farm showed pale yellow mosaic and a virus from them produced typical symptoms of a severe strain of AMV when inoculated to *Chenopodium* and tobacco. Preliminary trials by the N.A.A.S. with soil applications of D-D were showing very good promise in the south-west.

A major step forward in our knowledge of soil-borne viruses generally was the discovery of the role of nematodes in their transmission. In strawberry, the association of *Xiphinema diversicaudatum* Micol. with AMV was established jointly by Jha and Posnette (*Nature, Lond.* 1959, **184,** 962-3) and Harrison and Cadman (ibid. 1959, **184,** 1624-6): further knowledge on this aspect came from the work of Harrison and Winslow (*Ann. appl. Biol.* 1961, **49,** 621-33). Harrison, Mowat and Taylor (*Virology*, 1961, **14,** 480-5) concluded that *Longidorus elongatus* is a vector of the beet ring spot strain of tomato black ring virus in Scotland.

Lister (*Pl. Path.* 1958, **7,** 92-4) reported on RRV and AMV in Scotland, and his limited survey (*Pl. Path.* 1960, **9,** 102-5) showed that the latter virus might be widespread and important locally throughout England. He was able to prepare antisera to RRV and AMV directly from strawberry leaves (*Nature, Lond.* 1958, **182,** 1814). It has been shown that these two viruses and tomato black ring virus can be transmitted through strawberry seed (Cadman and Lister, *Proc. 4th Conf. on Potato Virus Diseases, Braunschweig*, 12-17 Sept., 1961, 17-21). Cropley, Ellenberger and Jha (*Rep. E. Malling Res. Stn, 1959*, 96-7), confirmed that the mosaic symptoms in strawberry are caused by a strain of AMV and not by the apple mosaic/plum line pattern virus which causes similar symptoms when transmitted to strawberries by grafting, and Jha (*J. hort. Sci.* 1961, **36,** 219-27) identified viruses transmitted by sap inoculation from strawberry plants with mosaic and yellow crinkle diseases to herbaceous hosts as strains of AMV. The mode of spread and control of strawberry viruses was discussed in general by Cadman (*Scient. Hort. 1957-8*, **13,** 80-6). Work on strawberry viruses at the Scottish Horticultural Research Institute, by Cadman and his colleagues, is summarized in the annual reports of this Institute throughout these years.

Streaky Yellows or **June Yellows,** the breakdown responsible for the elimination of Auchrincruive Climax as a widely grown cultivar was reported in individual crops from many parts of the country. Cambridge Favourite was most commonly affected but similar symptoms were seen on other cultivars also—Surprise, Cambridge Early Pine and Early Cambridge. In 1961 the trouble was quite common in Norfolk in Cambridge

Favourite. The experience with June Yellows up to the beginning of this 5-year period was discussed by Reid (*Scient. Hort. 1955-56*, **12**, 140). It was pointed out by Swarbrick (*Rep. Scott. hort. Res. Inst. 1957-58*, 30) that although June yellows was the most important kind of variegation in strawberry, it was not the only chlorotic behaviour in this host. He distinguished broadly two kinds of abnormality—variegation of the leaves persisting throughout the year and that appearing in spring and autumn but absent in summer. These chlorotic conditions were studied throughout these years at the Scottish Horticultural Research Institute and the general conclusions were given by Wills (ibid. *1960-61*, 49-51). Studies at the Institute confirmed that the causal agent of June yellows is non-chromosomal.

Summer Wilt, attributed primarily to adverse soil conditions, was noted in Essex and in some counties of the south-west in 1957. In mid-summer 1958, collapse of plants was common in Worcs and War especially in cv. Royal Sovereign, and was widespread and severe in S. Hants; in both areas lack of new roots was the main feature. In Hants new plantings suffered as much as older ones, and later-planted stocks were worse affected than earlier-planted ones. When plants from this county were examined for the presence of *Idriella lunata* Nelson & Wilhelm (see Nelson, *Phytopathology*, 1957, **47**, 438-43) chlamydospores resembling those of this fungus were present in quantity in the cortex of roots but were also plentiful in roots of healthy looking plants. The phenomenon was again prevalent in the Evesham Area in June and July 1959, especially in cv. Cambridge Vigour, but enlarged seeds were found on some fruits which suggested that the virus of green petal might be involved. The several affected crops in the Eastern Region in 1959 were mostly on silt soils. In 1960 there was less in the Evesham Area than in 1959, and no other reports were received in either 1960 or 1961.

Most crops of cv. Cambridge Favourite, and occasionally a few other cultivars, had a non-parasitic **Tip-burn** in the Tiptree area of Essex in 1957. The marginal tips of the young leaves were necrosed and, although not killed, the plants were rather poor and the trouble was having a serious effect on Cambridge Favourite. A similar condition was very common in 1961 in Devon and Cornwall especially in first-year crops; 75 per cent of an acre of Cambridge Favourite was affected.

In 1959 a yellow flecking and chlorosis of the young leaves of runners was very noticeable in several stocks of cv. Cambridge Favourite in S. Hants. Tests at East Malling for soil-borne viruses proved negative and it was thought that the very hot soil temperatures experienced that year were connected. Low temperatures may have been responsible for silvering of leaves in two localities in Devon and Cornwall in 1958. **Frost Injury** was suspected to be involved when cv. Redgauntlet fruits were mis-shapen in Norfolk in 1961 because of incomplete fertilization.

Raspberry

In 1958, fruit losses due to **Grey Mould** (*Botrytis cinerea* Fr.) were heavy in the East Midland Region and parts of the Starcross Sub-Region. Botrytis stem rot and die-back was recorded on a number of plantations during the five years and, in one instance, sclerotia were found under the

bark of dead canes. Studies at the Scottish Horticultural Research Institute on the autecology of the fungus, susceptibility of cultivars and control were reported by Jarvis (see annual reports of the Institute for this whole period).

Spur Blight (*Didymella applanata* (Niessl) Sacc.) was reputed to be on the increase in E. Suffolk during 1955-57 and was locally severe in 1957. In 1958, Worcs had more spur blight than usual and attacks were occasionally severe while, in Middx and Berks, cv. Norfolk Giant was sometimes badly affected. Reports were unusually few in 1960. Malling Promise was the main cultivar affected in the few slight to severe attacks of **Cane Spot** (*Elsinoe veneta* (Burkh.) Jenkins) in Norfolk in 1958, a year which brought particularly damaging outbreaks in the Starcross Sub-Region notably in cvs. Norfolk Giant, Malling Promise and Malling Landmark. Large areas of a plantation in Worcs died after infection with **Cane Blight** (*Leptosphaeria coniothyrium* (Fuckel) Sacc.) but no other severe attacks were reported.

Rust (*Phragmidium rubi-idaei* (DC.) Karst.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were also noted, 90 per cent of a half-acre plantation in Kent being affected with the latter. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was confirmed in Hants and Sussex, while *Verticillium* sp. contributed to the failure of a number of cultivars in a planting in Devon.

Jarvis and Montgomerie (*Rep. Scott. hort. Res. Inst. 1958-9*, 45) isolated a species of *Phytophthora*, apparently *P. cactorum* (Leb. & Cohn) Schroet. from roots of plants growing in waterlogged soil in eastern Scotland. The weakly parasitic **Black Blotch** (*Cryptosporium minimum* Laub.) was found to be associated with injury from wire supports in one instance in War; and the **Slime Mould,** *Mucilago spongiosa* Morgan, was growing round the bases of canes on a farm in Berks in 1960. Reports of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) came from Cumb and Devon, and abundant infection was seen in a crop of cv. Malling Promise in Ches.

The viruses and virus diseases affecting raspberry were discussed by Cadman (*Hort. Res.* 1961, **1,** 47-61). Considerable interest was being taken in soil-borne viruses, their transmission, properties and control, particularly at S.H.R.I., Mylnefield. Arabis mosaic virus (AMV) was known to cause **Yellow Dwarf** in cv. Malling Exploit, raspberry ring spot virus (RRSV) the disease known as **Leaf Curl,** and a strain of tomato black ring virus (TBRV) another disease. Susceptible cultivars had been severely affected by these viruses. AMV was reported as widely distributed, though local, in England but the other two had been found mainly in eastern Scotland. Cadman (*Rep. Scott. hort. Res. Inst. 1957-8*, 31-2) found a strain of RRSV infecting raspberry in Wilts which differed in some respects from Scottish strains. Harrison (*Ann. appl. Biol.* 1958, **46,** 221-9) isolated AMV from raspberry (provisionally naming it raspberry yellow dwarf virus). He showed that the virus formerly known as beet ring spot virus is a strain of TBRV (*J. gen. Microbiol.* 1958, **18,** 450-60): he also made detailed studies of RRSV and showed that both it and TBRV are soil-borne (*Ann. appl. Biol.* 1958, **46,** 571-84). Transmission of TBRV and RRSV through raspberry seed has been demonstrated (Cadman and Lister, *Proc. 4th Conf. on Potato Virus Diseases, Braunschweig*, 12-17 Sept. 1961, 17-21). The role

played by the nematode *Xiphinema* in outbreaks of AMV was studied by Harrison and Cadman (*Nature, Lond.* 1959, **184**, 1624-6) and Harrison and Winslow (*Ann. appl. Biol.* 1961, **49**, 621-33): the nematode was widely distributed in southern Britain in various soils. *Longidorus elongatus* is a vector of the beet ring spot strain of tomato black ring virus in plantations in Scotland (Harrison, Mowat and Taylor, *Virology*, 1961, **14**, 480-5).

Cadman (*Hort. Res.* 1961, **1**, 47-61) refers to a number of aphid-borne viruses present in raspberries in Britain. Some produce recognizable symptoms in some cultivars but not in others: when one of these viruses is present together with rubus yellow net virus the symptoms referred to as **Mosaic** are produced. The susceptibility of raspberry cultivars to raspberry **Leaf Spot** virus and raspberry **Veinbanding** virus varies greatly (Cadman and Fisken, *J. hort. Sci.* 1958, **33**, 13-20). The leafhopper-transmitted **Rubus Stunt** virus, or dwarf disease, was known to occur sporadically in the south. **Bushy Dwarf** was said to be the principal cause of failure in growth and cropping of cv. Lloyd George throughout Britain (Cadman, *Rep. Scott. hort. Res. Inst. 1959-60*, 51; ibid. *1960-61*, 58): the raspberry bushy dwarf virus is now referred to as a strain of apple chlorotic leafspot virus. Other virus diseases known to occur in Britain but about which little was known were **Curly Dwarf** (raspberry curly dwarf virus) and **Yellow Blotch** (cucumber mosaic virus) (see Cadman, *Hort. Res.* 1961, **1**, 47-61). A strain of cucumber mosaic virus affecting raspberries in Scotland was recorded by Harrison (*Pl. Path.* 1958, **7**, 109-11).

Chambers (*J. hort. Sci.* 1961, **36**, 48-54) freed raspberry plants from some aphid-borne viruses by heat treatment, and described methods for propagating virus-free plants. Virus-free raspberry stocks from heat-treated stocks at the Scottish Horticultural Research Institute were distributed from 1958 to growers in Great Britain by arrangement with the Department of Agriculture for Scotland. Great differences in the frequency with which plants became infected with the aphid-transmitted raspberry leaf spot and veinbanding viruses were found by Cadman and Fisken (*J. hort. Sci.* 1958, **33**, 13-20). Work was proceeding at S.H.R.I. on the genetics of resistance to raspberry viruses (Jennings, *Rep. Scott. hort. Res. Inst. 1958-9* and following reports). Cadman (*J. gen. Microbiol.* 1959, **20**, 113-28) described some properties of an inhibitor of virus infection obtained from raspberry leaves.

Waterlogging of soil caused die-back, collapse etc. in many parts of the country in 1961 and was noted in other years. In 1959 similar trouble was experienced in spring in several localities in Herefs, where cv. Malling Jewel was more severely affected than cv. Malling Promise, and in the south-east. Scorch or die-back associated with rusty supporting wires was an occasional trouble. For some years, cane **Die-back**, most commonly in Malling Promise, had become more troublesome in eastern Scotland: the particularly severe outbreaks in 1955 were suspected to be caused by winter injury (Wood and Robertson, *J. hort. Sci.* 1957, **32**, 172-83) though certain fungi were associated. The mycological aspects of the die-back were studied at S.H.R.I. (see *Rep. Scott. hort. Res. Inst. 1959-60* and succeeding years). The **Crumbly Fruit** condition, particularly found in cv. Malling Promise, was confirmed by Jennings and Tun (ibid. *1960-61*, 16) to arise as a result of somatic mutations affecting fertility.

Blackberry

A few severe attacks of **Purple Blotch** (*Rhabdospora ramealis* (Desm.) Sacc.) occurred in Kent, and the disease was noted in Norfolk and Worcs. **Cane Spot** (*Elsinoe veneta* (Burkh.) Jenkins) was not noticeably significant, but one or two extremely extensive infections of **Septoria Spot** (*Septoria rubi* Westend.) were encountered in Kent and Essex. **Rust** (*Phragmidium violaceum* (C. F. Schultz) Wint.) and **Stem Rust** (*Kuhneola uredinis* (Link) Arth.) received scant mention, but most canes in an acre of blackberries in Kent were affected with the latter in 1957. Mycelium of *Helicobasidium purpureum* Pat., the fungus causing **Violet Root Rot** was found in young plants in Essex in March 1959 by J. E. E. Jenkins. Other cane and bush fruits had previously been recorded as hosts of this fungus. Also recorded was **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer). There were one or two heavy attacks of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) in Norfolk, and a **Cane Gall** similar to that caused by *Agrobacterium rubi* in North America was serious in a number of plants in an Essex plantation in 1958. **Rubus Stunt** (rubus stunt virus), which was stated by Prentice (*J. hort. Sci.* 1950, **26,** 35-42) to be common in *Rubus* spp. in south-east England, was noted in Norfolk and Suffolk, while the common **Mosaic** symptoms were no doubt present in blackberry plantations generally. Harrison (*Ann. appl. Biol.* 1958, **46,** 221-9) found natural infection of blackberry by **Arabis Mosaic** virus (which he referred to as raspberry yellow dwarf virus).

In many plantations in Herefs and Worcs in 1958, the distal drupelets were shrivelled. Sometimes the first-formed fruits were normal, the intermediate ones abnormal, and the last-formed again normal. The condition was prevalent and was seen in hedgerow berries too.

Loganberry

Cane Spot (*Elsinoe veneta* (Burkh.) Jenkins) was above average in prevalence and severity in Herefs and Worcs, two of the main loganberry-growing counties, in 1958. Four plantations in Herefs were severely affected and, in one, the disease resulted in distorted fruit and a reduction in crop from seven to three tons. Canes and leaves in a few plantations were severely spotted in the Evesham area in 1957. Copper sprays, together with a cane-training method, gave useful control (Moore, *J. hort. Sci.* 1958, **33,** 96-107).

Also reported on occasions but of secondary importance were **Spur Blight** (*Didymella applanata* (Niessl) Sacc.), **Purple Blotch** (*Rhabdospora ramealis* (Desm.) Sacc.) and **Septoria Spot** (*Septoria rubi* Westend.) The odd instance of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) complete the record of fungal and bacterial diseases for this host. Legg (*Rep. E. Malling Res. Stn, 1959,* 102-3) reported that a virus was responsible for a decrease in yield of fruit and cane vigour, known for many years, which had led to a reduction in the acreage of loganberries in England. He proposed the name **Loganberry Degeneration** virus. By leaf-bud propagation, a new virus-tested loganberry clone was established (Hobbis and Campbell, *Rep. agric. hort. Res. Stn Univ. Bristol, 1957,* 65-8) from

which plants could be obtained by nurserymen through the Nuclear Stocks Association. Beakbane and Labern reported on the performance of some virus-tested clones (*Rep. E. Malling Res. Stn, 1959*, 48-51).

Blueberry

The first confirmed record, mentioned by Wilson and Henderson in *Br. Rust Fungi*, p. 40, of the striking and unusual **Witches' Broom Rust,** *Pucciniastrum goeppertianum* (Kuhn) Kleb., was made by L. Ogilvie and Miss M. Perrin of the N.A.A.S. A single bush was affected in a planting of "Fraser" blueberries among a fairly large collection of highbush blueberries (*Vaccinium corymbosum* L.) at the research nurseries of the Forestry Commission, Bere Regis, Dorset. It was derived from one of three rooted cuttings imported from the U.S.A. in 1953 and symptoms (Plate VI) were first noted in spring 1958. The bush was destroyed. Grove (*Br. Rust Fungi*, pp. 372-3) had earlier stated that the fungus had been found in England, Wales and Scotland on wild cowberry (*V. vitis-idaei*).

In 1958 in Dorset, blossoms and twigs were affected by **Die-back** (*Botrytis cinerea* Fr.) in one planting, and serious damage was caused to bushes in another. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was noted in Devon and Dorset. Gray and Everett (*Pl. Path.* 1961, **10,** 123-4) found *Fusicoccum putrefaciens* Shear and the *Phomopsis* stage (*P. vaccinii* Shear, Stevens & Bain) of *Diaporthe vaccinii* Shear, associated with cankers on twigs and die-back of young shoots, on two lots of plants originally imported into Britain from Holland and New Jersey and planted in Scotland. On a third planting, also of stock from New Jersey, both fungi were found in 1960 and, also, apothecia of *Crumenula urcedus* (Fries) de Notaris in 1961.

Diseases of Hop and Mushroom

Hop

Progressive Verticillium Wilt (caused by a virulent strain of *Verticillium alboatrum* Reinke & Berth.) was first recognized in English hop gardens in 1930, in Kent. Considerable spread occurred in the early years before the disease was investigated, and it was not until after the war years that statutory control was introduced (Progressive Verticillium Wilt of Hops Orders, 1947 to 1957*) to reduce further spread and to protect those areas not affected.

Up to 1948, progressive wilt was known only in the, mainly cv. Fuggle, gardens of the Weald of Kent but in that year it was recorded in a distinct group of farms to the north of the north Downs where mainly Golding-type cultivars were grown. Eradication attempts, involving drastic control measures, began in this area.

Spread continued in the Weald, where a few hundred hop farms were concentrated, and the disease became firmly established on most of them. The cultivar Fuggle was almost entirely replaced by wilt-tolerant cultivars. By 1960 something like three-quarters of farms in the Weald were known to be affected. In the area to the north of the Weald where 100 or so farms are situated, containment measures reduced the number of continuing outbreaks: in 1958 only 14 infected hills in three gardens were known to be affected but the five farms on which progressive wilt was newly recorded in 1959 brought the total of known-infected farms in the area to fifteen. In 1960 the disease recurred in three of the five new cases of 1959 and there was one fresh outbreak. By the end of 1961 the total of known infected farms in the northern area of Kent had reached 17 but, in the 1961 season, the disease was not detected in any plants on 13 of these farms.

In the exceptional 1959 season a proportion of plants of tolerant cultivars on several farms in the south-east showed symptoms of progressive wilt.

In 1960, a severe outbreak of progressive wilt was found on a farm in Hants. This was the first recorded outbreak in a group of farms around the Hants-Surrey border. The disease recurred in 1961 but was not found on any of the other farms in this area.

An important group of hop farms is situated in Worcs and Herefs. In 1957 the strain of *V. alboatrum* causing progressive wilt was confirmed in a hop yard at Rosemaund Experimental Husbandry Farm, Hereford: the whole yard was disbanded and there was no recurrence. The first outbreaks of progressive wilt on commercial premises in this west Midland area occurred in 1959 and 1960, both in Herefs. On one farm the infected yard was disbanded and, very shortly after, the farmer decided to relinquish hop-growing altogether. On the other farm the disease was found in a second yard but eradication measures resulted in no further infection in 1961 and intensive surveys in adjacent areas revealed no other outbreaks in this area where the situation continues to be satisfactory.

* The current order is the Progressive Wilt Disease of Hops Order, 1965.

Fluctuating Verticillium Wilt (caused by a mild strain of *Verticillium alboatrum* Reinke & Berth. and by *V. dahliae* Kleb.) varies with season and is widely distributed. It is not such a serious disease as progressive wilt but its effects can be severe in hop yards in the west Midlands and Hants. In the warm season of 1959 it was almost absent in all the hop areas. In contrast, 1958 and 1960, saw particularly bad attacks with some considerable losses in many yards: it was sometimes seen in yards where it had not previously been observed. In 1961 also, it appeared earlier, was more widespread and did more damage than usual in the west Midlands; and from the south-east there were many reports.

Talboys investigated host-parasite relationships and defence mechanisms (*Trans. Br. mycol. Soc.* 1957, **40,** 415-27; **41,** 227-41; 242-8; 249-60) in verticillium wilt; while Buxton and Hastie (see ibid. 1960, **43,** 696 and *Rep. Rothamsted exp. Stn, 1959,* 108-9) studied variation in *V. alboatrum* from hop. Sewell and Wilson (*Rep. E. Malling Res. Stn, 1957,* 126-8) showed that some common garden weeds were susceptible to infection by the strain of *V. alboatrum* which causes progressive wilt in hops. The development of cultivars to replace the sensitive ones, particularly Fuggle, continued and Wilson (ibid. *1958,* 110-5 and 161-2) reported on three new progressive wilt-tolerant cultivars, Density, Defender and Janus, which had recently been released.

The change over to machine-picking rather than hand-picking led to problems in handling and carriage of bine material to the machine. Martin (*Rep. Dep. Hop Res. Wye Coll. 1961,* 79-94) investigated handling risks and the disposal of waste residues after machine picking. Sewell and Wilson (*Rep. E. Malling Res. Stn, 1960,* 100-4) had demonstrated the highly infectious nature of machine-picked hop waste and with Martin (ibid. *1961,* 102-6) studied the effect of composting on infectivity. Talboys (*Pl. Path.* 1961, **10,** 162-3) investigated the time-temperature requirements for killing the fungus in the bine. Harris reported annually on the progress in research at East Malling on verticillium wilt (see annual report of the Research Station).

The effects of **Downy Mildew** (*Pseudoperonospora humuli* (Miyabe & Tak.) G. W. Wilson), in years favourable to it, caused increasing concern and continued to involve costly control measures. The disease was very prevalent and widespread early in the 1958, 1959 and 1961 seasons, and to an extent in 1957. In 1958 development continued throughout the wet season; but in 1959 the onset of unusually dry summer weather brought the disappearance of mildew, and crops remained virtually free that year both in the south-eastern and west Midland areas until picked, though a lot of bine had been lost. In 1961 dry conditions prevented later spread in west Midland yards but in the south-east much early bine had already been lost through secondary infections producing terminal and lateral spikes. There was no serious development in 1957 or 1960: in the former year, in the south-east, mildew was strikingly almost absent after the first spikes in the spring, a feature perhaps associated with cold conditions following earlier dry weather.

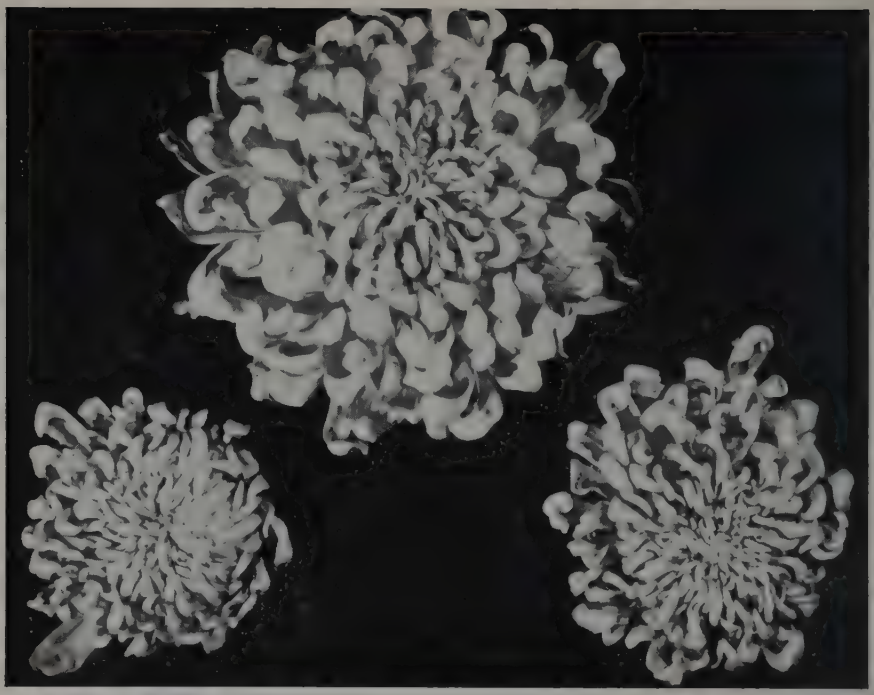
Throughout 1958, basal spikes were very numerous in the low-lying areas of the west Midlands while cone infection was almost universal except where copper had been used extensively and frequently during the whole season. Wet conditions made control difficult, and aerial spraying supplemented routine sprays on many acres. The major spread to cones in the

1. Carnation cuttings with lesions caused by *Alternaria dianthi* (pp. 156, 269).

2. Carnation leaves with ring spot (*Mycosphaerella dianthi*) (p. 156).

3. Carnation flower showing the wheat ear condition (p. 159).

PLATE VII



1. Three flower heads of a variant of Balcombe Perfection chrysanthemum, two partly and one fully open, showing 'crumpled petal' (pp. 165, 273).

2. Chrysanthemum petals showing 'crumpled petal' (pp. 165, 273).

PLATE VIII

area was in late July to early August; in many yards where mildew had not previously been experienced damage was very considerable.

In some gardens killing and weakening of rootstocks attributed to *P. humuli* was a worrying feature.

Little had been known about how *P. humuli* overwintered: Coley-Smith summarized knowledge to date (*Rep. Dep. Hop Res. Wye Coll. 1958*, 88-90) and made further studies (ibid. *1959*, 107-44) which suggested that the fungus could overwinter as mycelium in hop rootstocks and grow into the buds. This form of overwintering was confirmed in later reports in that series.

Research into the control of downy mildew continued at the Department of Hop Research, Wye College. Coley-Smith reported on the testing of hop cultivars for resistance (ibid. *1959*, 40-7). Reports on the work of Coley-Smith and Beard on dusting of hills with fungicides such as Bordeaux powder, and on that of various workers on spraying, including the preliminary trials with streptomycin, and accounts of the breeding work are to be found in the annual reports of the department.

Routine sprays of sulphur or dinocap often prevented serious damage by the potentially troublesome **Powdery Mildew** (*Sphaerotheca macularis* (Fr.) Lind). The disease was kept well in check in 1959, a year when powdery mildews generally were very much in evidence, but in the other dry summer, 1961, control became difficult in the south-east and loss of crop was appreciable. In the west Midlands in 1961, spraying checked the mildew except in 'Golding' yards in which mildew had been an annual problem and these had to be picked early. Little infection developed in 1960.

The other fungus diseases were of less importance. Early in 1958, **Canker** (*Gibberella pulicaris* (Fr.) Sacc.) seemed more prevalent than usual in the west Midlands but there was no undue development. In 1961, it was unusually severe in Kentish gardens in July and, as a result of the wet soil conditions in the winter, more widespread in the west Midlands than for several years. These soil conditions in 1961 led to increased bine losses from both canker and **Black Root Rot** (*Phytophthora citricola* Sawada). The latter was found at several places in Kent, Herefs and Worcs during these years particularly in cv. Bullion. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) had infected three bines in a hill of cv. Cobbs in Kent, at five feet above soil level. There were reports of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) from the south-east. **Grey Mould** (*Botrytis cinerea* Fr.) was noted on cones of Golding cultivars in Kent in 1958: the typical 'nose-rot' was very prevalent and not controlled by any of the usual sprays. In 1960 *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was associated with **Damping-off** of half of a stock of cuttings raised in very coarse sand under mist propagation in Worcs.

Nettlehead (virus complex including arabis mosaic virus combined with strains of prunus necrotic ring spot virus) continued to be very troublesome in the west Midlands. Many yards were involved and losses often heavy. The cultivar Bullion, thought to be resistant, was found to be affected too. In the south-east, spread was bad in 1957: the disease continued as a major trouble on many farms growing cv. Fuggle in Kent, but wilt-tolerant cultivars were mainly unaffected.

The spread of nettlehead was studied by Legg and Ormerod (*Rep. E.*

Malling Res. Stn, 1958, 157-60). Legg (ibid. *1960*, 106-7) investigated the increased sensitivity to the virus of cvs. Fuggle and Bramling after grafting them with scions of cv. Early Prolific. The extreme sensitivity of the latter appeared due to a latent virus (hop latent virus X) which shortens the incubation period of nettlehead virus and may increase the severity of symptoms. Legg has since renamed the latent virus, hop **Line-Pattern** virus (*Ann. appl. Biol.* 1964, **53**, 389-401). Interest was shown in a possible relationship between nickel content of plants and susceptibility to nettlehead (Legg and Ormerod, *Rep. E. Malling Res. Stn, 1957*, 129-32; Hudson, *J. Inst. Brewing*, 1957, **63**, 488-90). Legg (*J. hort. Sci.* 1959, **34**, 122-5) found that both nettlehead and **Split Leaf Blotch** (prunus necrotic ring spot virus) caused considerable yield losses in trials. This effect of split leaf blotch, which was not expected, and the prevalence of it in the widely planted cv. Fuggle led him to suggest that the disease must be regarded as one of the most serious in hops. The virus was very prevalent in the south-east in 1958, and in the west Midlands in 1959, but appeared to be less in evidence in other seasons. In Kent, Miss Jary has commented (*Rep. Dep. Hop Res. Wye Coll. 1961*, p. 105) that the large-scale planting of good stocks of cv. Fuggle N had gone a long way to reducing the problem at least for the time being.

In the west Midlands, **Mosaic** (hop mosaic virus) caused much anxiety early in 1958 but did not increase later that season and was, on the whole, less in evidence than usual in later years. In the south-east, 1958 was unusual for the great prominence of mosaic in Goldings and Golding cultivars. Legg (*Rep. E. Malling Res. Stn, 1958*, 116-7) found evidence that two types of hop mosaic, lethal and mild, are caused by strains of the one virus. Legg and Ormerod (ibid. *1960*, 105) proposed the name **Yellow Net** (hop yellow net virus) for a disease causing interveinal chlorosis of the leaves. Symptoms of the sap-transmissible **Chlorotic Disease** (hop chlorotic disease virus) were noted in the south-east. Progress in research on virus disease in hops at East Malling was reviewed annually (see Station reports) by Harris.

The non-parasitic **Hop Drop,** in which cones fall before becoming sufficiently mature to pick, was noted. The major-element deficiences were discussed by Thompson (*Rep. Dep. Hop Res. Wye Coll. 1958*, 40-50).

Mushroom

With an expanding mushroom industry, increasing attention was being paid to diseases of this crop. One of the, then, most puzzling diseases of any crop to create special attention in the late 1950's was that known variously as watery stipe, brown disease, La France or X-disease, later shown to have associations with virus infection (see p. 155).

Answers to a questionnaire (1957) from G.C.R.I., Rustington showed that growers believed **Cobweb Disease** (*Hypomyces rosellus* (Fr.) Tul. syn. *Dactylium dendroides* Fr.) to be among the more serious diseases (Gandy, *MGA Bull.* 1957, No. 95, 362-5). Trouble was experienced on several farms in the east Midlands during the summer of 1959, and attacks elsewhere were reported from time to time and were usually severe. Gathercole (ibid. 1957, No. 88, 138-41) successfully controlled cobweb with 20 per cent quintozene dust as also did Cleary (*Pl. Path.* 1958, **7**, 74-5); Wood

(*Mushroom News*, 1957, **6**, 256-7) found little risk of taint with this fungicide provided that it was correctly used: he (ibid. 1958, **7**, 6-9) gave a general account of cobweb. Another important disease, **White Mould** (*Mycogone perniciosa* Magn.) was seen each year, sometimes over very large areas of bed. In summer and autumn 1959 several outbreaks were reported in the east Midlands, and it was troublesome there on some farms in the following autumn and probably connected with heavy fly infestation, high humidities, and neglect of adequate precautions to prevent transfer from old to new crops. Infection built up in the South-eastern Region in 1960 and was present in most Lee Valley crops in 1961. The rare *Mycogone rosea* Link ex Chev. was widespread in a house in Som, but there was no indication of its origin. To what extent calcium chloride added to the casing layer in solution, affects the occurrence of *M. perniciosa*, was investigated in pot experiments by Flegg and Wyatt (*Rep. Glasshouse Crops Res. Inst. 1958*, 88-90). Wood summarized current knowledge of white mould in *Mushroom News*, 1960, **7**, 154-9.

Cephalsoporium constantinii Smith had previously only been found in one locality (Smith, *Trans. Br. mycol. Soc.* 1924, **10**, p. 90) but in 1959 it caused spotting of the cap in a small proportion of beds on a farm in Leics. Gandy (*Rep. Glasshouse Crops Res. Inst. 1957*, 129-33) recorded that what appeared to be the *Acremonium* sp. described by Bulloch (*MGA Bull.* 1950, No. 18, 24) had affected mushrooms in an experiment at G.C.R.I. The similarity was confirmed by Bulloch. The fungus was later identified by myself at the Plant Pathology Laboratory as *Cephalosporium lamellicola* Smith, the cause of **Gill Mildew,** and it seems that Bulloch's *Acremonium* sp. is probably identical with the latter. **Damping-off** (*Fusarium* sp.) was suspected in two patches of dwarfed mushrooms in a house in Worcs and **Verticillium Disease** (*Verticillium malthousei* Ware) was noted on a few occasions. Wood gave a general account of 'brown spot disease' (*V. psalliotae* Tresch.) in *Mushroom News*, 1958, **6**, 318-20. There were one or two complaints of **Bacterial Pit** (*Bacillus polymyxa* (Prazmowski) Migula); and **Bacterial Blotch** (*Pseudomonas tolaasi* Paine) was present generally in the Bristol area in 1958 causing 5-10 per cent losses. The latter was found in a few other crops and in one quite severe attack no control was obtained with chlorine. Gandy included these bacterial diseases among the most important diseases based on information from growers (*MGA Bull.* 1957, No. 95 362-5).

Mummy Disease was reported several times: in an attack in Leics it affected only a cream strain, the white strain growing normally even when in the same tray. The exact cause of mummy had been a matter for conjecture but Schisler, Sinden and Sigel (*Phytopathology*, 1968, **58**, 944-8) have recently found constant association with a species of *Pseudomonas*. An attack of **Hard Gill,** noted in Suffolk was confirmed by Miss Gandy who suggested that this disease may be an hereditary deformity occurring particularly in the later flushes. In this instance the first two flushes were unaffected and the third gave some gill-less mushrooms. The heating had been off for 10 days between the second and third flushes and the low temperature may have contributed to the abnormality; the night temperature was 1·7°C. The fourth flush was normal. Two of the few instances of **Rose Comb** (non-parasitic) could be connected with oil heating in the houses and

two others with oil-contaminated peat from a single source. **Stroma** (non-parasitic) caused 70 per cent failure in three houses in mid-Wales. Upturned gills with thickened stipes were characteristic of distortion in a house in Ches where woodwork had recently been treated with a proprietary preservative dissolved in solvent naphtha and a container of it had been left open.

Among bed invaders, the important **Yellow Mould** (*Myceliophthora lutea* Cost.) was frequent in Yorks E.R. in spring 1961 and several attacks were seen in June. *Myceliophthora* sp. has been seen on occasions, and a yellow mould in spent compost, agreeing with 'YM2' as reported by Gandy (*Rep. Mushroom Res. Stn, 1954*, 24-32) was seen in Sussex. Gandy commented in that report that various yellow moulds (YM1, YM2, YM3) might be present in quite large amounts in mushroom beds but their effect on mushroom production was unknown.

Brown Plaster Mould (*Papulaspora byssina* Hotson) and **Truffle** (*Diehliomyces microsporus* (Diehl & Lambert) Gilkey) were seen on a number of occasions. The latter caused an almost complete loss of one crop. Hawker (*Trans. bot. soc. Edinb.* 1959, **38**, 70-5) studied the development of the 'truffle' fruit body while Ramsbottom (*Mushroom News*, 1959, **7**, 99-100), in a popular article, discussed the change of name of *D. microsporus* from *Pseudobalsamia microspora* Diehl & Lambert and also mentioned that he had seen perithecia of *Lilliputia rufula* (Berk. & Br.) Hughes (syn. *Eurotium insigne* Winter) in a compost sample passed to him by Dr. F. C. Wood. This latter fungus has been recorded infrequently but may be common in composting material. **Olive Green Mould** (*Chaetomium olivaceum* Cooke & Ell.), **White Plaster Mould** (*Scopulariopsis fimicola* (Cost. & Matr.) Vuill.) and **'Red Geotrichum'** (*Sporendonema purpurascens* (Bon.) Mason & Hughes) made occasional appearances. Experience in the east Midlands indicated that composts with a high nitrogen content (2·3 to 2·5 per cent) were more likely to develop *Chaetomium* than those with a content of 1·8 to 2·2 per cent. Strong development of the mould in the compost after peak heating reduced the yield in several houses in the east Midlands in 1961, and was mainly due to overheating or lack of air during peak heating. Wood discussed the nomenclature of the fungus (*Nature, Lond.* 1957, **179**, 328).

There were three successive flushes of **Ink Cap** (*Coprinus* sp.) with no mushroom production in a Kent house in 1961: short composting for 10 to 12 days had been done. The mushroom casing-soil fungus *Dialonectria peziza* (Fr.) Cooke was seen in Som in 1961 and a competitor, probably *Hypholoma dispersum* (Fr.) Sacc., occurred regularly on the entire cropping area on a Glos farm. In 1957, Wood (*Nature, Lond.* 1957, **180**, 283) found *Heleococcum aurantiacum* Jørgensen, a fungus not recorded since 1935, in compost samples.

Various types of abnormal mushrooms appearing in commercial beds have long been known and Sinden recognized La France in this country some years ago, after first describing it in the U.S.A. in 1950. During the 1950's English growers complained sporadically of reduced yields with poor or distorted mushroom growth: many attacks were attributed to La France. When in autumn 1956, and the first few months of 1957, concern arose at the numerous outbreaks, characterized by big crop losses, premature cessation of growth, malformation of the sporophores and de-

generation of the mycelium, occurring in most of the growing areas, the names 'watery stipe' and 'brown disease' began to be used, but a very wide range of symptoms and effects were encountered with apparently no factor common to all outbreaks. While bearing certain resemblances to it, the disorders appeared to be distinct from mummy disease, but many outbreaks had much in common with La France. After that epidemic the troubles very largely disappeared until 1961, though they reduced yields on several east Midland holdings in autumn 1958, and crops were affected in some west Midland counties and on a few farms in the east in 1959. The trouble gave cause for further concern in 1961. Gandy (*Rep. Glasshouse Crops Res. Inst. 1959*, 129-33; *MGA Bull.* 1958, No. 100, 140-6) discussed some of the abnormalities and, with Flegg (*Proc. 3rd int. Conf. Biol. Cult. Mushrooms, Paris, 1965*, 128-37), has classified types of abnormal sporophore collected in this country. Storey (*MGA Bull.* 1958, No. 100, 185 *et seqq.*) discussed the problem. Research work, notably by Miss Gandy at G.C.R.I., Rustington, (see Annual Reports for 1957-61 incl. and *Ann. appl. Biol.* 1960, **48,** 427-30), continued because of the fear by growers of further epidemics.

Much has been said and written about these problems, but a major step forward was taken when an association of abnormalities with virus infection was found. Material from outbreaks was examined at G.C.R.I. and the condition transmitted by inoculation into healthy beds. Gandy (*Nature, Lond.* 1960, **185,** 482–3) studied the behaviour of colonies from diseased and healthy rhizomorphs on agar media and obtained transmission from the former to the latter. With the confirmation that virus plays a direct part in these disorders came the use of the term **Die-back** to describe those conditions involving progressive deterioration of mycelium, much reduced cropping, death of sporophores before maturity, waterlogging of stipe and other tissues and various sporophore abnormalities (Gandy and Hollings, *Rep. Glasshouse Crops Res. Inst. 1961*, 103-8; Hollings, *MGA Bull.* 1962, No. 156, 526 *et seqq.*; Hollings, *Nature, Lond.* 1962, **196,** 962-5). Environmental conditions seemed to play a large part in the development of the disorders, and the beneficial effects of altering the air conditions within the cropping houses was demonstrated (Storey and Lester, *Mushroom Sci.* 1959, **4,** 430-41). Various general accounts of the disorders appeared in *MGA Bull.* (Nos. 96, 100 and 127).

Diseases of Ornamental and Miscellaneous Plants

Carnation

There has been a big increase in the total acreage since 1945 and perpetual flowering carnations are one of the most widely grown of the florists' flowers under glass. Losses due to wilt diseases were at one time heavy but with the adoption of new cultivation techniques, including the testing of cuttings for freedom from *Verticillium*, *Fusarium* and parasitic bacteria, and the consequent availability of wilt-free propagating material, the problem became much less. The technique screens out those cuttings carrying organisms, but does not distinguish between pathogenic and non-pathogenic species. It began to be practised successfully on a number of the bigger commercial nurseries, but was sometimes unsatisfactory when cuttings were rejected at a high rate, not because wilt organisms were present but because of the difficulties of surface sterilization when very heavy populations of saprophytes were present on stock mother plants. A discussion on the technique was given by Jenkins (*Pl. Path.* 1959, **8**, 23-7); and work was done on the contamination and sterilization aspect by Ebben (*Rep. Glasshouse Crops Res. Inst. 1958*, 54-7), who also studied the fungal flora of steamed and unsteamed carnation soils, the growth and survival of fungi in soil and composts and (ibid. *1957*, 125-6) species of Caryophyllaceae as alternate hosts for *Verticillium* and *Fusarium* spp. Full details of the method of testing cuttings for wilts were given in 'Carnations under Glass' (**Bull. Minist. Agric. Fish. Fd*, 151, 1961).

Apart from those caused by viruses, **Verticillium Wilt** (*Verticillium cinerescens* Wr.) was still the most troublesome disease on carnation nurseries, particularly where the plants were not grown on raised or concrete beds. Some losses were serious. In 1957, however, it was below average in the Lee Valley and, in 1958, crops there were more free than for several years previously.

As usual, **Die-back, Stem Rot** and **Foot Rot** diseases caused by *Fusarium culmorum* (W. G. Smith) Sacc., were fairly common, and at times widespread in some areas. There were some bad attacks in the propagating stages. Stem rot was often associated with deep planting. A disease which had become more common, especially during propagation and in young plants, was **Leaf Spot** (*Alternaria dianthi* Stev. & Hall) (Plate VII, 1). Mist propagation greatly favours the fungus. Numbers of attacks, some serious, were seen in Essex, Herts, Sussex and Surrey, on cuttings imported from Denmark. Stems were sometimes affected. There were occasional attacks elsewhere: in 1959 it was recorded for the first time in Lancs. Late in 1957, **Grey Mould** (*Botrytis cinerea* Fr.) was very general in parts of the Eastern Region; and early in 1959 it affected flowers on several Lee Valley nurseries, sometimes to up to 20 per cent of open blooms. Otherwise it was infrequently reported, but now and then caused severe petal, bud or flower rot and stem die-back.

Ring Spot (*Mycosphaerella dianthi* (Burt) Jørstad (Plate VII, 2) was more

* Now in third edition: *A Manual of Carnation Production*, Bulletin No. 151, 1967.

serious than usual in Herts and Beds in the winter of 1956/7. During this and the other seasons a number of very heavy attacks were reported from various parts of the country, with complete destruction of some plants. Cultivars differed in their susceptibility. In an attack in Dorset the fungus was noted on the sepals. **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *dianthi* (Prill. & Delacr.) Snyder & Hansen) and **Leaf Spot** (*Septoria dianthi* Desm.) were rarely recorded. **Leaf Rot** (*Heteropatella valtellinensis* (Trav.) Wr.) received little attention but was noted once or twice in Devon and was newly recorded in the Yorks and Lancs Region. **Powdery Mildew** (*Oidium* sp.) was troublesome only very sporadically but was very serious on some nurseries in the extreme south-west in 1959 especially on yellow cultivars. **Foot Rot** (*Phytophthora* spp.) was very infrequent, but extensive in an occasional crop. Species identified were *P. nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. and, in Middx, *P. cryptogea* Pethybr. & Laff. One or two attacks of root or stem rot were attributed to *Pythium* sp. or *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. *Pythium* caused damping-off of seedlings on a nursery in Kent. **Rust** (*Uromyces dianthi* (Pers.) Niessl) was common and usually slight; records came mainly from the Eastern Region. **Anther Smut** (*Ustilago violacea* (Pers.) Fuckel) was noted twice only—in southern counties.

Jenkins (*Pl. Path.* 1958, **7**, 76) recorded **Greasy Blotch** (*Zygophiala jamaicensis* Mason) for the first time in this country in the winter of 1956/7. It had been known in California, U.S.A. (Baker and Davis, *Phytopathology*, 1953, **43**, 585). Loss of bloom, both on the foliage of cuttings and of the flower crop, was apparent in a Herts nursery early in 1957, and the disease was also present on a nursery in Beds that spring. Affected cuttings apparently grew poorly and often died. The blotch was later seen in several nurseries in the Lee Valley; also in Westmorland, Sussex, Surrey and Devon. Normally it was not serious, but symptoms were extensive and severe in a few crops, though only during periods of high humidity.

Slow Wilt (*Erwinia chrysanthemi* Burkh. *et al.*) was first found in this country in 1954 (Lelliott, *Pl. Path.* 1956, **5**, 19-23) in Essex; and later in Sussex and Herts. During the succeeding years it caused serious losses. However, by 1957 changes in propagating practice and the restrictions imposed on imported cuttings by *The Importation of Carnation Cuttings Order*, 1956* had brought about a sharp reduction in incidence and it has since been rare. Reversion to older propagating methods could well have resulted in the disease building up again. In 1957, the wilt occurred in several crops in the Lee Valley but it was not often serious in the 1957-planted crop. No attacks were seen in the Valley and neighbouring areas in the 1958 crop. There were a few outbreaks in Middx, Sussex, Kent and Surrey in 1957 and one only (Sussex) in 1958. Since then only one outbreak has been recorded—severe damage to a crop in the Starcross Sub-Region in 1961. Strains of the bacterium, differing in virulence, were inoculated by Ebben (*Rep. Glasshouse Crops Res. Inst. 1959*, 61) into six cultivars of carnation, and some differences in susceptibility were noted. The rather

* This order was revoked later but the restrictions were incorporated into the general importation of plants orders, the current one of which is the Importation of Plants, Plant Produce and Potatoes (Health) (Great Britain) Order 1971.

similar **Bacterial Wilt** (*Pseudomonas caryophylli* (Burkh.) Starr & Burkh.) has only been seen twice here. It was first isolated by Lelliott (*Pl. Path.* 1956, **5**, 19-23) in one plant in a sample from a wilting stock in Herts: this stock had been imported in 1954 from Holland. In 1958 it was detected in a few plants in a batch imported from Denmark into the Lee Valley. In the U.S.A. where the temperatures are often higher than in this country the disease causes heavy losses.

Following the work of Kassanis at Rothamsted (*Ann. appl. Biol.* 1955, **43**, 103-13) on ring spot, mottle, vein mottle and latent virus, Hollings, Stone and Norrish studied carnation viruses at G.C.R.I. (see *Rep. Glasshouse Crops Res. Inst, 1959, 1960* and *1961*). In particular they indexed stocks of commercial cultivars to assess their virus content and then tried to obtain virus-free plants by tip culture and by heat treatment. A great advance was their success in producing virus-free plants.

Viruses are prevalent in commercial stocks. At least eight had been identified in Britain by the end of this period, but the significance of some was not yet known. Carnation **Mottle** virus was the most widespread, and stocks of some cultivars, such as the Sim group, were probably wholly infected. On its own, mottle virus causes slight chlorotic mottling of the younger leaves, but mature plants may show no leaf symptoms. Although mottle virus can, by experimental inoculations infect some plants other than carnation, this is unlikely to occur in practice. Kassanis (*Ann. appl. Biol.* 1955, **43**, 103-13) had found that it was not possible to eliminate mottle virus from plants grown at 38°C for four weeks, nor from small cuttings (2-4 cm long) taken immediately after heat treatment. Hollings and Stone (*Rep. Glasshouse Crops Res. Inst. 1961*, 100-2) confirmed this; they also took tips (0·25—1 mm long) from plants kept at 38°C for four weeks and grown in tubes of sterile nutrient. While some of the surviving tips were provisionally thought to be free from mottle and some were infected, others gave a reaction on *Chenopodium amaranticolor* quite unlike that of mottle virus both in the size of the lesion and in the period of latency. Further transfers to other plants of *C. amaranticolor* however restored the characteristics of mottle and the normal virulence. Obviously, thorough and repeated testing is needed when this technique is used, to ensure true freedom from the virus. Mottle virus, like ring spot, is spread from plant to plant by handling and plant contact, and no vector is known. Carnation **Ring Spot** virus was much less prevalent than a few years previously, usually being found in stocks of older cultivars. Damage is severe, infected plants being stunted and often distorted. The virus may sometimes cause flower colour breaking in red and pink cultivars. Once isolated from carnation, the virus is readily transmissible by inoculation to a wide range of plants, although carnation is almost certainly the only effective source of infection for this crop. Fortunately heat therapy or tip culture easily eliminates it.

The aphid-transmitted carnation **Vein-Mottle** virus, though extensive in sweet williams in gardens, is less common than ring spot or mottle. A virus called carnation **Latent Virus** by Kassanis, is present in commercial stocks, but has not been known to cause symptoms. It can, however, increase the severity of infection of other viruses when present with them. Kassanis (*J. gen. Microbiol.* 1956, **15**, 620-8) found evidence that carnation latent virus, though differing to some extent antigenically, is serologically related to

potato virus S and paracrinkle virus (M). Van Slogteren *et al.* in Holland, have demonstrated distant serological relationship not only between the latent virus and potato viruses S and M but also between these and chrysanthemum virus B (*Nature, Lond.* 1962. **195**, 835-6).

Carnation **Etched Ring** appeared to be fairly widespread on some cultivars. Hollings and Stone gave a preliminary report on it (*Rep. Glasshouse Crops Res. Inst. 1960*, 94-5) and later, both by aphid and mechanical transmission, it was established as a virus disease by Hollings, Stone and Norrish (ibid. *1961*, 70-3). The prominent chlorotic spots, flecks and rings are rather like those of ring spot. Its severity varies according to the cultivar of carnation, but of those tested Joker was the most badly affected. In the Lee Valley, Essex and Beds in 1961 it was regularly found in crops of Joker, and in some instances up to 80 per cent of the plants showed symptoms. Hollings (ibid. *1959*, 65-7) has also reported **Alfalfa Mosaic** virus and a virus of the tobacco ring spot type on this host. Hollings, Stone and Norrish (ibid. *1961*, 72-3) isolated a virus, unlike any previously known, from cv. Dusty, grown in Italy and from cv. Orchid Beauty, from the U.S.A., by sap inoculation to *Chenopodium amaranticolor* and *Gomphrena globosa*. The virus reacted with antiserum to pelargonium leaf curl virus, as did the latter with antiserum to the carnation virus, and was thought to be a strain of the pelargonium virus. It is also serologically related to tomato bushy stunt virus and has been referred to as carnation **Italian Ring Spot;** it appears not to be of economic importance (Hollings *et al.* ibid. *1962*, 88-9). A full account of this virus appeared recently (Hollings, Stone and Bouttell, *Ann. appl. Biol.* 1970, **65**, 299-309).

There was no proof that carnation **Streak** is due to a virus but there was circumstantial evidence. Hollings reported (*Rep. Glasshouse Crops Res. Inst. 1961*, 72) that he had seen symptoms of streak, in commercial stocks here, like those described by American workers, and which he himself saw in the U.S.A. Typical streak symptoms were reproduced when such affected carnations were grafted to healthy ones of the same cultivar.

With **Wheat Ear** (non-parasitic), the flower organs consist entirely of bracts and the axis is elongated, so that the flower resembles an ear of wheat (Plate VII, 3). Both wheat ear and normal flowers can be found on the same plant. The trouble is reported periodically and there were one or two outbreaks in 1957. It was seen in 1959 and for a few years previously at two nurseries, under one ownership, in the South-eastern Region. The grower noticed a few affected cv. Wivelsfield Crimson plants in 1953 at one of the nurseries. No wheat ear appeared in further crops from the same stock, and until 1957 none was seen in any other cultivar on the nurseries. In that year cv. Barbara Brigham crops on both nurseries developed the disorder. On one nursery, 85 per cent of 1,500 plants, propagated in August 1956, produced at least one flowering stem with wheat ear in the following summer. However, no wheat ear developed on plants raised from the same stock on another nursery and propagated in September 1956 and February 1957, but a batch of 300 plants propagated in August produced two or three affected shoots. Many other cultivars, planted under similar conditions at the same time, were unaffected. In 1958 and 1959, wheat ear again appeared in Barbara Brigham to the extent of 1-2 per cent.

Symptoms due to deficiency of trace elements have been uncommon in

the system of culture used for perpetual flowering carnations but, as Butters has pointed out, the trends towards the use of soluble fertilizers rather than bag fertilizers and manure did involve the possibility of deficiency symptoms arising, particularly boron deficiency. He discussed symptoms of the latter and remedial measures (*Grower*, 1960, **54**, 406-7). Messing (*J. Sci. Fd Agric.* 1958, **4**, 228-34) described symptoms of deficiency disorders in young and mature plants of several cultivars grown in sand cultures at G.C.R.I. and reviewed the literature on mineral nutrition of carnations.

All plants of cv. Golden Rain in a small batch in Worcs showed **Flower Greening** in 1958.

Chrysanthemum

The very considerable increase in commercial interest in chrysanthemums in these and recent years meant a greater concern with disease losses on the part of the growers. The increased production, the growing of new cultivars and changes in growing techniques no doubt contributed to a rise in significance of certain diseases. Several new diseases made their appearance. However, flower distortion, due to tomato aspermy virus, while at one time the disease of major concern to the industry became rather less in evidence.

Recognized only very sporadically in this country since 1936, **Flower Scorch** (*Itersonilia perplexans* Derx) came strikingly into prominence in 1958 and 1960 though it attracted relatively little attention in the other years. It was, however, seen for the first time in the Northern and South-eastern Regions in 1957. In 1958, the 144 cultivars at the Royal Horticultural Society's gardens, Wisley, were each affected and no resistance was apparent in any (Stone, *Rep. Glasshouse Crops Res. Inst. 1958*, 53). 1958 also saw its first appearance in the west Midlands and the Lee Valley, and in that year, and in 1960, attacks were widespread and severe in many parts of the country, and on some nurseries it was extremely serious. Blooms suffered badly both in outdoor crops and under glass when humidities were high; crops finished in Dutch light structures or in unheated or badly heated glasshouses were particularly involved. Fungicides gave variable results and were still in the investigational stage. Smith (ibid. *1961*, 82) found some control with freshly-precipitated zineb in trials.

The fungus also occurs on flowers of weeds of the Compositae: in 1960 it was found at Bristol on scentless mayweed (*Matricaria maritima* var. *inodora*), and in Glos on daisy (*Bellis perennis*) and groundsel (*Senecio vulgaris*). Gandy (ibid. *1961*, 68) collected several infected weed species of the Compositae in Norfolk, also a *Veronica* sp., and successfully inoculated a number of other cultivated and weed Compositae. She also isolated *Itersonilia* from sunflower (ibid. *1960*, 70). Dahlia cultivars, especially pompoms, were attacked in 1958, and Stone (ibid. *1958*, 53) obtained the fungus from leaves, but only when they were also infected with *Entyloma dahliae*. She isolated *Itersonilia perplexans* from petals of pyrethrum, zinnia, tagetes, cosmos, gaillardia and gerbera and leaves of chrysanthemum, and found that an isolate from a parsnip canker failed to infect chrysanthemums, while isolates from the latter did not attack parsnips.

Though previously not recorded in this country, **Ray Blight** (*Mycosphaerella ligulicola* Baker, Dimock & Davis) was found in 1959 in nine nurseries in

the Wye Sub-Region and in three in the Lee Valley. Of those in the south-east, seven could be attributed to infected propagating material distributed by one of the others. Usually the *Ascochyta* stage (*A. chrysanthemi* Stev.) was present, but the perfect stage had been seen on stems. The symptoms were more or less as described by Baker, Dimock and Davis (*Phytopathology*, 1949, **39**, 789-805). In addition to the conspicuous dark stem lesions often associated with a node (Plate IX, 1), flower symptoms were found on a few nurseries. Later that year, infection of rooted cuttings and of mature plants was seen in several 'all the year round' crops in the Lee Valley.

In the next two years, ray blight was seen on a few nurseries in Sussex and Surrey and the Lee Valley, and appeared for the first time in Leics, Worcs, Staffs, Suffolk, I. of Ely, Hants, I.W., Glos, Devon, Cornwall and Mon—mainly in individual nurseries. Infection was evidently being carried to new areas with cuttings. Shoesmith cultivars were among the most severely affected. Infection can be particularly severe in propagating beds, especially under mist. Spread of this disease in the U.S.A. was alarming and it became increasingly destructive there in the 1950's.

A significant **Root Rot** caused by a species of *Phoma* had not long been recognized in this country, but was seen in many areas, and often causing severe damage. It was first seen in autumn 1959 at Wye. In 1961, it was found in several nurseries in the Midlands, the Eastern Region including the Lee Valley, the Wye Sub-Region and the South-western Region. Symptoms were similar to those reported by Ebben (*Rep. Glasshouse Crops Res. Inst. 1960*, 70) who found a species of *Phoma* affecting plants from three sources, the fungus resembling that described by Kemp in Canada (*Canad. J. Pl. Sci.* 1958, **38**, 464-76). Hawkins, Wiggell and Wilcox (*Pl. Path.* 1963, **12**, 21-2) have reported on the disease in England.

A **Stem Rot** showing as a superficial black rotting at the base, particularly of cv. Iceberg and apparently associated with a species of *Pythium*, has been seen in several areas since 1959 when it appeared on a number of Lee Valley nurseries. Some lesions extended over $\frac{3}{4}$ of the stem length in mature plants. Similar symptoms were seen in plants from Hants, Surrey and Sussex. Typical *Pythium* oospores and sporangia developed on isolates from affected plants. In 1960 and 1961, the trouble again occurred in the Lee Valley with several outbreaks in the Northern, Yorks and Lancs, West Midland, Eastern and South-eastern Regions, the Wye Sub-Region and Cornwall. Shoesmith cultivars, have also been affected. The extent of infection varied but was sometimes appreciable. In some instances *Pythium ultimum* Trow was identified. On a Worcs nursery in 1960, cv. Fred Shoesmith plants showed a reddish-brown 'foot rot' with vascular discoloration to well above the rotted area. Approximately 1-5 per cent of one batch raised from bought-in cuttings was affected. All the infected plants were under the ridge of the heated glasshouse and liable to receive drips. Isolations were made from vascular tissues; Miss G. Waterhouse tentatively identified the isolate as *Pythium paroecandrum* Drechsl. and had previously suggested this to be the fungus isolated from basal stem lesions of a batch of plants from the Lee Valley. In 1961 this same fungus was noticed in an attack on Iceberg in Worcs and in another on Shoesmith in Beds.

Downy Mildew (*Peronospora radii* de Bary) was recorded by Wilcox for the first time on cultivated chrysanthemums in 1960 (*Pl. Path.* 1961, **10**,

40-1), being found on the florets of Yellow Top, an American spray cultivar in a Sussex nursery in September: infection was slight on a few other cultivars. The conidiophores were on both surfaces of the outer florets with dark violet masses of conidia. Leaves were not infected. Two further outbreaks, on cv. Iceberg, were reported from Sussex in 1961. *P. radii* is recorded in several European countries on weed members of the Compositae.

H. J. Wilcox noted that flowers of cv. Snow Dance, received from Surrey in October 1961, bore small necrotic spots with reddish margins on a number of florets. Larger spots had watersoaked margins and produced chains of *Alternaria* spores. Spores taken from lesions were atomized onto healthy flowers of cvs. Snow Dance, Primrose Coralie and Red Coralie and similar lesions developed, on which the fungus sporulated, within 48 hours. Spores from single cultures, when atomized onto flowers of Snow Dance, produced typical spots from which Wilcox reisolated the fungus. He also successfully inoculated chrysanthemum leaves and cineraria flowers and leaves. Wilcox reported on these outbreaks and described the fungus in *Pl. Path.* 1963, **12**, 137. No other descriptions of *Alternaria* species attacking chrysanthemum flowers had been traced in this or other countries.

Blotch (*Septoria chrysanthemella* Sacc.) was reported sporadically from a few counties from 1957-9, though only one outbreak was drawn to the attention of advisers in the latter year. In 1957 it was common in the south-west. It was frequently seen in 1960 and 1961 in most parts of the country and was fairly widespread in some areas though often not of much significance. Some attacks were, however, severe. In west Wales and Dorset in 1961, it was commonly thought to be on the increase and in the former occurred on most nurseries. Sometimes blotch is troublesome on cuttings. Up to 1960, *S. chrysanthemella* was the only *Septoria* species recorded on cultivated chrysanthemums in this country. Moore (*Br. Parasitic Fungi*, pp. 356-7) pointed out that further study was needed on the species on this host in Britain. Wilcox and Falconer (*Pl. Path.* 1961, **10**, 124) observed American spray cultivars on a nursery in W. Sussex in 1961 with symptoms very similar to those described in Germany by Schneider (*Phytopath. Z.* 1959, **34**, 269-84) for *S. obesa* Syd. The first record for Europe was in Berlin in 1957 (Schneider, *loc. cit.*) The Sussex fungus agreed with *S. obesa*, having larger spores than *S. chrysanthemella:* spores sizes ranged from 64·8 to 108·0 μm (mean 90·0 μm) with up to 10 septa. Corresponding measurements for *S. chrysanthemella* were 46·8 to 75·6 μm (mean 61·9 μm) with up to five septa. *S. obesa* is known in the U.S.A., Europe and the Far East. Two further attacks were severe in Surrey crops in 1961, and the fungus was confirmed at three sites in Norfolk. Infection with *S. obesa* tended to occur higher up on plants than did that with *S. chrysanthemella.*

The common **Grey Mould** (*Botrytis cinerea* Fr.) often caused heavy loss of blooms, particularly in cold structures or glasshouses where heating was inadequate or ventilation poor. Stems, cuttings and stool beds were occasionally affected and, in 1960, there were outbreaks of neck rot on a few nurseries, notably in the particularly soft cultivar Rival's Rival. In attacks in the east Midlands the fungus had entered at a leaf, penetrated the stem, and caused complete collapse of the flower stalk just below the bud. Shoesmith cultivars were among those whose blooms were apparently more susceptible to grey mould. Taylor and Muskett (*Pl. Path.* 1959, **8**, 57-9) reported on a severe

flecking of florets caused by *B. cinerea* in a Dutch light structure in Northern Ireland. **Powdery Mildew** (*Oidium chrysanthemi* Rabenh.) as usual appeared fairly commonly. It was present on petals at the Bryn Adda Horticultural Station in 1960. Dinocap was being increasingly used for control though some cultivars may be damaged. Read (*Rep. Glasshouse Crops Res. Inst. 1957*, 148-9) obtained satisfactory control of mildew on a limited number of cultivars with both salicylanilide and dinocap in combination with a petroleum emulsion. The antibiotic griseofulvin gave marked control of mildew under garden and commercial conditions according to Rhodes *et al.* (*Ann. appl. Biol.* 1957, **45**, 215-26). **Rust** (*Puccinia chrysanthemi* Roze) was mentioned sparingly in reports, but was occasionally severe and at times locally prevalent in Dorset and Suffolk. While rust was heavy on certain pot-grown cultivars on poorly-managed nurseries in Glos, the Mayford family appeared to be resistant under these conditions. **Verticillium Wilt** (*Verticillium* spp.) occurred on many nurseries in various parts of the country and was frequent at times in some areas. By 1960, it was said in the East Midland Region that wilt caused by *V. dahliae* Kleb. was becoming widespread in stocks there but was often slight and apparently not affecting bloom production. In 1961 the fungus was isolated from a high percentage of plants in a number of stocks in the Region but its effects were not severe and were sometimes not noticeable. Although wilt has usually been attributed to *V. alboatrum* Reinke & Berth.; in the south as well as in the east Midlands *V. dahliae* is often the fungus isolated.

Foot and Root Rots and **Damping-off** of cuttings were fairly frequent particularly in the north and mainly due to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. Occasionally attacks were due to species of *Phytophthora* or *Pythium*. Blackening of lower leaves was associated with *Pythium* in a crop in Wilts in 1960. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was infrequently noted but was extensive in two crops. A number of attacks of **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were recorded but only occasionally were they severe. In Pemb in 1960, potted plants with stem rot symptoms bore tiny sclerotia unlike those of *S. sclerotiorum*, but all techniques tried failed to produce apothecia. A **Leaf Spot,** caused by a species of *Phyllosticta* was noted in Carms in 1960: the only previous record of *Phyllosticta* on this host in England and Wales came from Glam. The fungus *Tricholoma nudum* (Bull.) Quél invaded beds at a Northumb site in 1957.

Crown Gall (*Agrobacterium tumefaciens*(Smith & Townsend) Conn) and **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) were noted on a few occasions, and the latter was sometimes very severe. Seventy-five and 80 per cent were examples of the infection by leafy gall in stools of mixed cultivars and there were other serious attacks: most of a stock of 6,000 plants was attacked in Surrey. Almost the whole of a stock was severely attacked by crown gall in the south-east but flowering has not been very adversely affected.

Pith breakdown, hollow stems with bacterial rotting and brown staining of the vascular tissue occurred in a few crops. About 300 plants on a Lee Valley nursery were affected in June 1958, during and just after rooting. A few stems in another 'all the year round' crop bore black areas about six weeks after planting. There were several more attacks in 1958 mainly in cv.

Fred Shoesmith, with black lesions on stem bases extending 4-10 in. upwards. In most attacks bacteria, probably *Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye, were isolated.

Wilting of the growing points with disorganization of the pith and often an external black streaking, affected a few plants of cv. Pacesetter in W. Sussex in 1958; the symptoms resembled bacterial wilt (*Erwinia chrysanthemi* Burkh. *et al.*) but only *E. carotovora* var. *carotovora* could be isolated. Plants from other nurseries, but originally from the same source, showed similar symptoms. Stem inoculations into tomato under high temperature and humidity produced a similar pith rot, but further inoculations into chrysanthemums were unsuccessful.

Rot at the base of the flower head, starting in the stalk immediately below the neck or in the capitulum is a symptom which has been known since Williams (*Rep. exp. Res. Stn, Cheshunt, 1927*, 32-8) first described the condition. A number of different species of bacteria have been isolated, and while the trouble is thought to be bacterial in origin, no causal agent has been confirmed. Crops on two nurseries in the South-eastern Region were affected in 1959 and two crops in Devon in other years: in each instance bacteria were isolated, and in an attack in the Wye Sub-Region a species of *Pseudomonas*. In 1961, specimens were received from two Lee Valley nurseries on which a number of blooms were lost due to stem rot below the flower bud. Bacteria, thought to be of a species of *Pseudomonas*, were isolated in both instances. Blackening of the disc florets and twisting and pointing of the flower buds were seen on cv. Shoesmith plants on a nursery in Pemb and were associated with a *Pseudomonas* sp. A breakdown of the capitulum in several cultivars in Som in 1957 was possibly bacterial in origin. Death of the terminal bud with necrosis of the pith and wood of the pedicel was seen in November 1960 at three places in the South-western Region, similar symptoms being noted in previous years. Sometimes slight bacterial ooze was present inside the stem. A species of *Pseudomonas* caused a stem and flower rot at three nurseries in the Starcross Sub-Region in 1960 and a bud rot of cv. Loveliness, associated with a species in the same genus was investigated in the Wye Sub-Region.

At the beginning of the period, **Flower Distortion** (tomato aspermy virus) was still widespread with high amounts of infection in some stocks, but in the last year or two it declined in commercial stocks presumably due to the increased use of heat treatment and a greater awareness of the disease by growers. Graham (*Pl. Path.* 1957, **6**, 15-7) reported the extensive distribution of aspermy throughout stocks in South-east Scotland. At G.C.R.I., chemical treatments were tried for therapy of virus-infected cuttings (Howles, *Pl. Path.* 1957, **6**, 46-8). The properties of this virus and its relationship with cucumber mosaic virus were investigated by Govier (*Ann. appl. Biol.* 1957, **45**, 62-73). **Stunt** (chrysanthemum stunt virus) was at one time rare and of little significance here, apparently being confined to a few nurseries. Spread seemed negligible and plants could be freed from the virus by heat treatment, though later another English isolate could not be eliminated in this way. With the importation and growing of more American cultivars, notably spray types, the much more virulent **American Stunt** was introduced and this cannot be eliminated from plants by heat. This virus had caused great losses in the U.S.A., and after about 1958 very high incidences were found in some stocks here. Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 104; *1960*, 75;

1961, 73-4) discussed American stunt virus and the failure both of efforts to purify it and of heat treatment and meristem culture to cure it.

Chrysanthemum virus **D** is also important, though probably rare. It causes severe flower distortion and has been found in many cultivars, but is not always easy to distinguish by symptoms from the effects of aspermy virus. In 1960 it was noted in several counties in the west Midlands, symptoms agreeing with those of D being produced on *Chenopodium amaranticolor*. Chrysanthemum virus **B** causing **Mild Mosaic** is widespread in stocks but relatively harmless, causing no or very slight symptoms except occasionally when it occurs with certain other viruses. It has been discussed by Hollings (*Ann. appl. Biol.* 1957, **45**, 589-602). Chrysanthemum **Vein Mottle** virus is prevalent and very damaging, but in a number of cultivars, though present, it causes no symptoms. Chrysanthemum **Ring Spot** virus has little effect on plants, though on some cultivars, e.g. Roseverne and Friendly Rival, it produces conspicuous leaf symptoms early in the year which later disappear.

Also present in commercial stocks are chrysanthemum virus **E**, which distorts flowers, and **Dwarf Mottle** (a virus complex) which is similar to the virus Q reported in the U.S.A. **Cucumber Mosaic** virus is rare; and very rare are tomato **Spotted Wilt** virus, and **Latent Virus** isolated from cv. Shirley Late Red but according to Hollings (*Ann. appl. Biol.* 1957, **45**, 589-602) apparently of no significance to chrysanthemum production. **Necrotic Mottle** (a virus complex) is found in several cultivars and can be severely damaging. It is present in many cultivars without inducing symptoms. Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 67-8) reported that **Green Flower** (chrysanthemum green flower virus) had occurred in a number of stocks of cv. Balcombe Perfection and certain of its sports.

General accounts of chrysanthemum viruses have been given by Prentice (*Scient. Hort. 1957-58*, **13**, 90-6) and Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 67-8). The technique of heat therapy was most promising for the production for propagation of small nuclei of plants freed from aspermy, English stunt and ring spot viruses. The technique is ineffective, however, for American stunt, viruses B and D or vein mottle. Heat therapy has been described by Hollings and Kassanis (*Jl R. hort. Soc.* 1957, **82**, 339-42) and by Hollings (*Q. Bull. natn. Chrysanth. Soc.* 1957, No. 31, 5-8). The possibilities of meristem culture for producing virus-free stocks were being investigated.

'Crumpled Petal', a malformation peculiar to cv. Balcombe Perfection and its sports became increasingly common in the late 1950's and often serious. The twisting and strong incurving with crumpling and dimpling of the florets (Plate VIII, 1, 2) meant many unsaleable blooms. Experiments by Hollings at Plant Pathology Laboratory, Harpenden indicated that the abnormality was not caused by viruses or other infectious agents, and that although related cultivars were susceptible, a genetic factor was not directly responsible. What evidence we have suggests that some cultural factor, possibly during initiation or development of buds, and only affecting Balcombe cultivars, is the cause. In some areas the symptoms were often widespread during 1958-60, notably in the East Midland, Eastern and South-eastern Regions. Numbers of stocks had very high proportions of flowers affected, occasionally to 100 per cent. However, after 1960, hardly any reports

were received. In 1958, a flower and floret distortion more like 'crumpled petal' than symptoms of aspermy virus was seen in several parts of the South-eastern Region, affecting cvs. American Beauty and Jane Ingamells with almost a whole crop affected at Efford Experimental Horticulture Station.

Another type of flower malformation in Balcombe Perfection and its red and golden sports occurred on several Norfolk nurseries early in 1960. The florets were not incurved but resembled those in a 'cactus' type dahlia bloom. Below the flower, the stems were thin and weak with small bract-like leaves, and the stem thickened below the first disbudded node. The stocks came from different sources, and possible contributing factors were the abnormally high temperatures (24°C recorded in one house) and long daylight hours in early October, late disbudding and the rather hard type of growth, possibly with insufficient watering.

All blooms on all plants of a number of 'Favourite' cultivars on a nursery in Ches showed symptoms resembling 'crumpled petal' in 'Balcombe' types. Flowers had petaloid stamens with severe petal distortion, but no colour break. All affected cultivars had been exposed to frost on two consecutive nights in late September: unaffected blooms were on plants not exposed to the frost. All affected blooms had high populations of mites.

A condition said by growers to be common on first-formed flowers was seen on nurseries in the west Midlands in 1957. On one nursery, first-formed blooms of cv. Loveliness had tubed florets and there were similar symptoms on cv. Balcombe Red Robe with excessively tubed florets with terminal pores.

Dwarfing of plants following prolonged heat treatment was noted in a few instances. **Sun Scorch** was found once or twice to have caused brown patches on petals of plants under glass. Non-parasitic troubles such as **Oedema, Topple, Cold Chlorosis, Fasciation, Blindness** and **Manganese Deficiency** were occasionally reported. Batches of cuttings propagated in sand and left in too long after rooting developed symptoms of **Potash Deficiency** on a Norfolk nursery but while cvs. White Hope Valley, White Bernier and Avondale showed symptoms, Mayford Supreme and Snowball, with the same treatment did not.

The diffuse yellow-brown areas on leaves, characteristic of injury by the fungicide dinocap were occasionally noted on susceptible plants such as the 'Balcombe' and 'Shoesmith' cultivars. A startling chlorosis, sometimes with necrosis, was reported to be affecting a wide range of cultivars in the South-eastern Region in 1958, and was apparently associated with the use of dinocap for mildew control. Weaker growths were usually the more seriously affected. Cultivar Silversmith seemed to be particularly prone to injury by various chemicals.

A leaf scorch seen on several nurseries in the Lee Valley in late autumn 1959 was associated with the use of acetone-based aerosols at low temperatures. Symptoms resembling those of magnesium deficiency appeared within two or three days of the insecticide dimethoate being applied to potted plants of several cultivars, outdoors and under glass, in Lindsey (Lincs). When potted chrysanthemums were sprayed experimentally with dimethoate at the Regional H.Q. Shardlow, identical symptoms were produced. There were a few reports of decay of the base of cuttings and of stools due to excessive application of hormone power. Several other fungicides and insecticides caused injury to foliage etc. on occasions.

DISEASES OF OTHER ORNAMENTAL AND MISCELLANEOUS PLANTS

ACIDANTHERA *Botrytis* sp. caused severe **Corm Rot** in a batch in Cornwall. *Sclerotinia draytonii* Buddin & Wakef. (*Botrytisg ladiolorum* Timmerm.) is known to cause corm rot in this host (Plate X, 2).

AGERATUM **Damping-off** (*Pythium* sp.) was noted in Norfolk.

ALSTROEMERIA A first occurrence of **Violet Root Rot** (*Helicobasidium purpureum* Pat.) on *Alstroemeria aurantiaca*, from Holland (Lincs) in 1959, was described by Fletcher and Hawkins in *Pl. Path.* 1960, **9**, 76. **Foot Rot** caused by *Phytophthora* sp. was noted in Cornwall in 1960.

ALTERNANTHERA *Colletotrichum* sp. was associated with an outbreak of **Root Rot** in Lancs.

ALYSSUM One or two attacks by **Downy Mildew** (*Peronospora galligena* Blumer) on seedlings were severe, including one on *A. saxatile* in Yorks W.R. in 1960. Seedlings of *A. maritimum* in boxes on a nursery in the Yorks and Lancs Region were infected in 1960 by a *Peronospora* sp., but while the spores agreed with those of *P. parasitica*, inoculations to cabbage gave negative results. In 1961 mildew was general, sometimes severe, on the lower leaves of plants of *A. minimum* cvs. Snow Carpet and Rosie O'Grady in War. As in the above attack, conidial measurements agreed with those for *P. parasitica*. Apparently mildew, though rarely serious, had occurred on alyssum on this holding for many years. *Pythium* sp. was responsible for odd instances of **Damping-off** in Sussex and Mon in 1958, *Phytophthora* sp. for severe losses due to **Foot Rot** on a nursery in Middx in 1961, and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., for severe and widespread **Foot Rot** on a Sussex holding in 1958.

AMARYLLIS **Leaf Scorch** (*Stagonospora curtisii* (Berk.) Sacc.) was recorded in Berks and Cambs.

ANEMONE In late summer 1957, some of the attacks of **Downy Mildew** (*Peronospora ficariae* Tul.) in Devon and Cornwall were severe even where the rotation gap had been three years, and the fungus was well established in most beds by the end of the year; many crops, especially in W. Cornwall were completely infected. In the Cheddar area of Som, some attacks became moderate to severe. Again, in late 1958, mildew was widespread in Devon and Cornwall and seriously reducing quality and quantity of flowers. Slight or moderate attacks were seen in other years in the south-west and a few crops had infection in other widely scattered parts of England and Wales. In 1961, infection was found on 5 September on a Devon nursery, and spread from primary sources was considerable: it had been seven years since the previous crop. In the same year, infection in mid-Wales was first seen on 2 August.

The disease was probably the limiting factor in anemone production on small farms in the south-west. Trials with soil sterilants on contaminated sites had given variable results according to season and further work on soil sterilization and control of the disease by spraying continued at Rosewarne Experimental Horticulture Station, Cornwall throughout these years.

Early in 1957, **Grey Mould** (*Botrytis cinerea* Fr.) caused widespread

destruction of forward crops on many holdings in the South-eastern Region following frost damage. In October 1960 prolonged wet weather with high winds encouraged the fungus to establish itself in W. Cornwall: crowns rotted and foliage collapsed in some crops. By November a high proportion of blooms from a number of crops in the county had to be discarded, though in the extreme west, growth was less forward and crops were very clean. Infection was heavy in many places in the Truro area, and 25-50 per cent of the flowers in many crops were unmarketable. Autumn attacks were seen also in Devon and Caerns that year. *Itersonilia perplexans* Derx was also associated with flower spotting in the south-west and it began to seem likely that it is this fungus and not *Botrytis* that is responsible for most of the damage to flowers especially where the symptom is a marginal browning of the petals. There was very little comment on grey mould from anywhere in other years, though crown rot due to *Botrytis* was to cause severe damage to the few crops which survived the high winds and cold weather of December 1961 in Devon and Cornwall. Sprays and dusts were tested by Jeff (*Proc. Br. Insecticide and Fungicide Conf. Brighton 1961*, **2**, 321-6) for the control of *Botrytis*.

In August 1960, plants received at the Starcross sub-centre from Devon and Cornwall showed a petiole collapse at and just below soil level. A shrunken, shrivelled area extended for varying lengths ($\frac{1}{2}$ to $1\frac{1}{2}$ in.) along the petiole. This or a similar condition had been seen in the previous years, particularly during the hot dry summer of 1955. Previously no pathogen could be isolated but, in this 1960 season P. Wiggell isolated a *Phytophthora* sp. from affected tissues. In some specimens the fungus had reached the corm, the tissues of which had broken down. Losses of about 5 to 10 per cent were experienced on one holding and the bed was very 'gappy'. A similar collapse of the leaves was associated with *Phytophthora* sp. and *Pythium* sp. respectively in two places in Cornwall in 1961.

Three moderate or severe attacks of the uncommon **Downy Mildew** (*Plasmopara pygmaea* (Ung.) Schröt.) were recorded, while **Powdery Mildew** (*Erysiphe polygoni* Mérat) appeared on a few crops in Devon and Cornwall in 1959, and sometimes disfigured the flower stems. **Cluster Cup Rust** (*Tranzschelia pruni-spinosae* (Pers.) Diet.) was noted only from Oxon, Glos and Pemb, while *Rhizoctonia* sp. was associated with **Stem Rot** in a crop in Cumb in 1960. A **Slime Mould,** possibly *Licea flexuosa* Pers., was present on petals and leaves of a crop in Cornwall.

In the South-western Region in 1957, **Anemone Mosaic** (strain of turnip mosaic virus) had spread considerably by autumn, apparently by aphids in late September, and at least half of some fields showed symptoms. Flower breaking was occasional in most beds examined in Devon and Cornwall in September. Almost all the crops in Devon surveyed in autumn 1960 had some infection, some of them high amounts, but in Cornwall incidence appeared to be slight. Symptoms were prevalent in Som in 1961, and were occasionally seen in other areas in this and other years, with a few serious attacks. Although mosaic was common before 1957 it had not been recorded until Hollings described it (*Ann. appl. Biol.* 1957, **45**, 44-61). **Cucumber Mosaic** virus was noted on a few individual nurseries in the Eastern Region, Som, Kent and Sussex. It was confirmed in a very severe attack in Kent in April 1958 when mottling, stunting,

crinkling and some necrosis were seen, and plants were poor with button-type heads. Half of an infected crop in 100 ft of frames in Sussex was unmarketable. Many enquiries, concerning severe browning and death of foliage, were received in the South-eastern Region during the season up to March 1960, mostly in S. Hants but also in Berks, Bucks and I.W. In some instances almost the whole crop was lost. Cucumber mosaic virus was isolated in the majority of surviving plants examined but adverse weather and soil conditions were believed to have been involved. A single plant affected with **Anemone Brown Ring** (virus) was found in a field in Cheddar in November 1956. The disease appeared to be uncommon, as no other infected plants were noticed in anemone fields in the south-west, and was described by Hollings (*Pl. Path.* 1958, **7**, 95-8). **Anemone Necrosis** (virus) is referred to on p. 275.

Failure of flowers to colour, thought to be due to low light intensities, gave trouble in a cloche-raised crop in Worcs in November 1957; 30 per cent of the flowers were green, but the following January the percentage had decreased to five. An example of **Fasciation** (non-parasitic), in which flowers were two-headed, was seen in Worcs: with warmer weather later, normal flowers were produced.

Winter Browning was reported in some crops. It has been seen for many years in anemones and from circumstantial evidence was ascribed to unfavourable cultural conditions. Although the disease can be caused by anemone mosaic virus, a similar reaction may occur through environmental or cultural factors.

ANTIRRHINUM **Downy Mildew** (*Peronospora antirrhini* Schroet.) was severe on seedlings or young plants on about a score of nurseries in widely scattered sites from Northumb to Cornwall, but cultivars varied in susceptibility. The seed-borne aspect of **Leaf Spot and Stem Rot** (*Phyllosticta antirrhini* Syd.) had previously had little attention in this country, though demonstrated in the U.S.A. Dr. E. Gray had recorded a severe check to seedlings in 1949 at Kirkwall (Orkney), almost certainly attributable to seed-borne infection. In spring 1960, about a dozen enquiries from the west Midlands concerned symptoms, caused by this fungus and varying from severe and extensive damping-off in seed boxes, to leaf spotting (Plate X, 1), malformation and distortion of older seedlings after pricking out. Tests on left-over seed showed infection by *P. antirrhini*. Rosser has described the attack (*Pl. Path.* 1961, **10**, 126). In 1961 many boxes had to be discarded on a number of nurseries in War and Salop, and infection was found in several seed samples. There were a number of other records of severe stem rot or damping-off during the five years.

Rust (*Puccinia antirrhini* Diet. & Holw.) appeared very sporadically in most years in England and Wales. Greater prevalence than usual was recorded for S. Wales in 1957 and for Worcs in 1961, and rust was widespread in parts of the Eastern Region in 1959 and 1960, and in gardens in the south-west in 1961. Non-resistant cultivars were sometimes severely affected. Zineb was proving itself a useful fungicide in controlling attacks on crops forced under glass. *Pythium* and *Phytophthora* spp. or *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. caused numbers of attacks of **Damping-off** and **Root Rot** each year, sometimes with big losses: seed dressings gave good control in some instances. Outbreaks were numerous

in the South-western Region in 1958. **Verticillium Wilt** (*Verticillium sp.*) appeared in one Lee Valley crop under glass and was severe. The effects of the supply of nitrogen upon the various species of *Verticillium* causing wilt in this host were described by Isaac (*Ann. appl. Biol.* 1957, **45**, 512-5). A fungus, with sclerotia of 3-4 mm diameter was associated with wilt and stem rot on a holding in Cornwall in 1960. White mycelium appeared on the stem, and smaller sclerotia (1-2 mm) were produced in potato-dextrose agar cultures. Similar sclerotia were found on diseased chrysanthemums on the same site in the previous season.

AQUILEGIA **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was found attacking aquilegia for the first time; in 1958 in the Peterborough area.

ARABIS In private gardens in the Aberystwyth area, **White Blister** (*Albugo candida* (Hook) O. Kuntze) was common in 1961 but was successfully controlled with zineb sprays.

ARUM LILY There were records of **Leaf Spot** (*Phyllosticta richardiae* Brooks) each year: in one attack yellowing and defoliation resulted. This disease was much more prevalent than usual in S. Wales in 1958. Specimens from Dur and Cumb had **Root Rot** (*Phytophthora cryptogea* Pethybr. & Laff.). A species of *Cladosporium* was present on spots on spathes of plants in a badly ventilated house in Glam in 1957. Bacterial **Soft Rot** was seen occasionally, and **Spotted Wilt** (tomato spotted wilt virus) was recorded in a few stocks.

ASH A group of a dozen trees in Kent had many branch cankers caused by **Bacterial Canker** (*Pseudomonas savastanoi* (Smith) Stevens f. *fraxini*). **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) occurred in this host several times.

ASTER (*Callistephus*) *Alternaria alternata* (Fr.) Keissler (syn. *A. tenuis*) attacked seedlings in boxes in N. Wales in 1961—a record believed to be the first of the fungus on china asters in this country. There were several records of **Stem Rot** (*Botrytis* sp.), **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz. and *Pythium* sp.), **Root Rot** or **Foot Rot** (*Phytophthora* spp. including *P. cryptogea* Pethybr. & Laff. and *P. nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.) and **Wilt** (*Fusarium oxysporum* Fr. f. *callistephi* (Beach) Snyder & Hansen). A few of the attacks, particularly by *Fusarium* and *Phytophthora*, were heavy, for example a stock of over 2,000 asters cv. Lilliput was destroyed in Ches in 1957. About 90 per cent of cv. Lilliput and 10 per cent of cv. Powder Puff were dying with **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) in a $\frac{1}{4}$ acre outdoor crop in Sussex in 1959. Symptoms of **Aspermy** (tomato aspermy virus) were noted at Bangor, and **Dodder** (*Cuscuta* sp.) was found on a few occasions. On a Herefs nursery, dodder seriously contaminated seed boxes: the species was tentatively identified at Kew as *C. campestris*, a native of U.S.A. and frequent as a weed there.

AUBRETIA **White Blister** (*Albugo candida* (Hook) O. Kuntze) was noted for the first time on this host, in 1958. It appeared in Staffs and Glos; and was recorded several times in 1960 and 1961, mainly in gardens in Surrey and Berks, occasionally being severe. Previously the disease was found in several localities in Scotland (Henderson, *Pl. Path.* 1955, **4**, 110). **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was recorded in Surrey.

AZALEA see Rhododendron.

BALSAM Symptoms of **Cucumber Mosaic** virus were seen in a crop of *Impatiens balsamina* in Oxon in 1960, growth being poor, and flowers and some leaves distorted; leaves were mottled.

BARBERRY *Verticillium alboatrum* Reinke & Berth. was isolated from cuttings failing under 'mist' propagation in Berks in 1958.

BEECH **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was recorded.

BEGONIA **Powdery Mildew** (*Oidium begoniae* Oudem.) was general in the South-eastern Region in 1959 and in Middx in 1960: there were a number of other records. Dinocap was successfully used on occasion. **Damping-off and Foot Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) of leaf cuttings were recorded on a few occasions. **Bacterial Blight** (*Xanthomonas begoniae* (Takimoto) Dowson) was noted in Hants. Tomato **Spotted Wilt** and **Cucumber Mosaic** viruses have occurred in this host.

BOX One record of **Rust** (*Puccinia buxi* DC.) was made in Devon, while Green and Brooks (*Jl R. hort. Soc.* 1959, **84**, p.530) noted the fungus in 1959. **Arabis Mosaic** virus was confirmed in edging box plants in Surrey in 1960: the infected plants showed only slight yellowing of the leaf margins. Eelworms (*Xiphinema* sp.) were later isolated from soil around the roots of the plants.

BRACKEN Large areas were dying out at a site in Denbigh in 1961 and *Corticium anceps* (Bres. & Syd.) Gregor (see Gregor, *Phytopath. Z.* 1935, **8**, 401-19). was present on the dead rhizomes.

BROOM **Die-back** (*Pleiochaeta setosa* (Kirchn.) Hughes) was noted in Dorset in 1957 and had not been seen before in the South-western Region. This trouble on *Cytisus* spp. had been described earlier by Green and Hewlett (*Jl R. hort. Soc.* 1949, **74**, 310-2).

BUDDLEIA Cuttings in the South-eastern Region in 1960 were severely damaged by **Foot Rot** caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. **Cucumber Mosaic** virus can affect this host severely.

CACTUS Basal rots were attributed to *Botrytis* and *Rhizoctonia* in propagating houses in Glam. A corky, oedematous condition was seen occasionally in Wales, possibly associated with fairly high humidities.

CALCEOLARIA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) appeared on potted plants in Cards in 1958 when contaminated leaf mould was used. Many plants were affected with **Root Rot** (*Phytophthora cryptogea* Pethybr. & Laff.) on a Berks nursery in 1957, and *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. caused root and foot rots in two nurseries, in Lancs and Surrey respectively, in 1959. **Pythium Root Rot** was recorded in 1957 in Lancs, and a crown rot due to *Botrytis* sp. in Glam in 1959. **Cucumber Mosaic** virus was confirmed in a Kent stock in 1957.

A disorder of calceolarias, **'Yellows'**, had been recognized for a number of years, appearing in small amounts in several areas. Diffuse yellowish or chlorotic areas near the leaf tips develop in late autumn. Small patches only on a few leaves may be affected but complete yellowing of many leaves occurs on some plants. Leaves can be slightly puckered, but flowers apparently show no symptoms. By early spring the yellowing fades and

young leaves are normal; by May symptoms may be difficult to find, though vigour may have been reduced. M. Hollings found, at Plant Pathology Laboratory, Harpenden, that the condition was unlikely to be a mineral deficiency or soil abnormality. He was unable to transfer the condition mechanically or with aphids, nor could he transmit it to several test plants in other families. There was no definite evidence of natural spread, and occurrence was seasonal.

CALENDULA **Smut** (*Entyloma calendulae* (Oudem.) de Bary) was seen in the Scilly Isles in 1961. Brady (*Trans. Br. mycol. Soc.* 1960, **43**, 31-50) examined the life-cycle of this fungus in detail.

CAMELLIA **Leaf Spot** (*Pestalotia guepini* Desm.) was associated with necrosis of the tips of cuttings on one Surrey nursery, and *Pestalotia* sp. was seen on potted plants under glass on another. Brooks (*Jl R. hort. Soc.* 1966, **91**, p. 4) reported the occurrence, presumably in a garden, of **Gall** (*Exobasidium camelliae* Shirai) on a specimen received from Cornwall in 1961. The only previous report appeared to be that of Dennis and Wakefield (*Trans. Br. mycol. Soc.* 1946, **29**, 142) in Sussex in 1944. Camellia **Yellow Mottle Leaf** virus was seen in several Regions in 1960 and 1961 and was quite common in stocks. It was associated with flower breaking in some cultivars, but a virus complex might have been involved.

CAMPANULA Stem and leaf rotting due to **Leaf Spot** (*Ascochyta bohemica* Kab. and Bub.) was seen in Lancs in 1961, **Rust** (*Coleosporium tussilaginis* (Pers.) (Lév.) appeared on *Campanula persicifolia* on a nursery in Glos and was seen once or twice in gardens, and **Cucumber Mosaic** virus was recorded in Cambs.

CAPSICUM *Didymella lycopersici* Kleb. was noted on specimens from Middx in 1958. **Foot Rot**, associated with *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., severely damaged seedlings in Middx in 1960.

CEANOTHUS Cuttings being propagated under 'mist' in Berks in 1958 and 1960 were severely rotted by *Rhizoctonia* sp..

CEDAR **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was seen.

CHEIRANTHUS A bed of this was badly affected by **Club Root** (*Plasmodiophora brassicae* Woron.) in Middx in 1959.

CHERRY (flowering) see Prunus.

CHESTNUT (*Castanea*) **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was recorded on sweet chestnut.

CHRYSANTHEMUM (For florists' chrysanthemum see p. 159). **Verticillium Wilt** (*Verticillium* spp.) was seen a few times in *Chrysanthemum maximum*, and *V. dahliae* Kleb. was confirmed in one of the attacks.

CINERARIA **Powdery Mildew** (*Oidium* sp.) was general in Middx in 1959 and outbreaks were medium to heavy. In S. Wales, attacks were very prevalent under glass both in 1959 and 1960. In 1960, several types of a mixed stock in Beds were infected and cleistocarps were found on the plants. These were identified as belonging to *Sphaerotheca fuliginea* (Schlecht.) Salm. (= *S. fusca* (Fr.) Blumer)—the first time that the perfect stage of the cineraria powdery mildew had been found in this country. *S. fusca* was recorded in Holland on cultivated cinerarias in 1951 (von Arx, *Tijdschr. PlZiekt.* 1952, **58**, 10-3).

Leaf Spot (*Alternaria senecionis* Neergaard) was at times serious. Records came from Yorks, and several counties in the south and east. In

one crop, captan gave good control. On a Kent nursery, while spotting occurred on older leaves of all plants in frames, no plants under glass were affected. **Rust** (*Coleosporium tussilaginis* (Pers.) Lév.) was fairly common in the southern half of the country, and **Foot and Root Rots** (*Phytophthora* spp.) were rather frequent with some substantial losses. *P. cryptogea* Pethybr. & Laff. and *P. nicotianae* B. de Haan var. parasitica (Dastur) Waterh. were sometimes specified in reports. In one case only was *Pythium* found to be associated with root rot. The only reports of **Downy Mildew** (*Bremia lactucae* Regel) came in 1959 from the south-west and in 1960 from Lancs: it had previously been seen in Northants in 1954. A species of *Fusarium* was associated with a wilting of flowering plants in Glos in 1958; the trouble may have been aggravated by overwatering. **Aspermy** (tomato aspermy virus) was reported in cinerarias in mid-Wales in 1961. Tomato **Spotted Wilt** and **Cucumber Mosaic** viruses are known to occur in this host.

CITRUS **Oedema** (non-parasitic) severely blistered the undersides of the leaves of some ornamental citrus plants sprayed with white oil in the Lee Valley.

CLARKIA **Foot Rot** (*Phytophthora* sp.) affected half the plants in a house in Kent in 1957. *P. cactorum* has previously caused foot rot in this host in Scotland.

CLEMATIS A species of *Ascochyta* was present on wilted plants investigated in Som. Clematis wilt has for long caused concern, but at that time none of the fungi associated with it had been shown to be a causal agent. However, Ebben and Last (*Rep. Glasshouse Crops Res. Inst. 1965*, 128-31) have since investigated the relationship of *Ascochyta* to this condition. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted in Cards in 1960; it had not been recorded before on this host. Extensive browning of foliage in a Salop planting was caused by **Powdery Mildew** (*Erysiphe polygoni* Mérat). Virus diseases received little attention.

COLCHICUM **Smut** (*Urocystis colchici* (Schlecht.) Rabenh.) was found on potted plants in Glam in 1958—a new county record.

COLEUS **Damping-off** (*Pythium* sp.) was reported from Norfolk.

COPROSMA **White Root Rot** (*Rosellinia necatrix* Prill.) was recorded in the Isles of Scilly, where it was previously found on this host in 1956.

CORNUS In 1961, an interesting **Root and Crown Rot** (*Phytophthora* sp.) appeared in a small stock of 3-year old seedlings of *C. nuttalii* in Surrey. The fungus, readily isolated, resembled *P. cinnamomi* Rands.

COTINUS There were a few reports of **Verticillium Wilt** in *Cotinus coggyria* (syn. *Rhus cotinus*) from Worcs, Hants, Glos and Surrey, mostly attributed to *V. dahliae* Kleb. In a nursery bed in Worcs, infection by this fungus was associated with wilting of about 50 trees which later died. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was seen in several plantations.

COTONEASTER Severe **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) has been common in *Cotoneaster* spp. since 1959 (Billing *et al.*, *Pl. Path.* 1959, **8**, 152), particularly in gardens and parks in the south and south-east of Greater London. The disease survives the winter in this host. *C. horizontalis* has not been attacked even when conditions might have been expected to favour infection if this species were susceptible.

Armillaria Root Rot (*Armillaria mellea* (Fr.) Kummer) and **Fasciation** (non-parasitic) have been observed.

CRASSULA Of interest was a record of **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) from Middx in 1960.

CRINUM A consignment of bulbs from Holland in 1958 appeared healthy but, when stored, **Bulb Rot** (*Fusarium oxysporum* Fr. f. *narcissi* Snyder & Hansen) developed.

CROCUS Diseases of crocus were apparently not conspicuous as no reports were received.

CYCLAMEN **Grey Mould** (*Botrytis cinerea* Fr.) caused flower rot in many crops in Worcs in 1958 and 1959. It has been troublesome on several other nurseries. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was seen in most years, and a few instances of root rots have been associated with *Nectria radicicola* Gerlach & Nilsson (syn. *Cylindrocarpon destructans* (Zins.) Scholten) or with *Pythium* sp. **Cucumber Mosaic** and tomato **Spotted Wilt** viruses occur in cyclamen stocks. On a nursery in Kent, leaves were malformed on 40,000 seedlings in boxes under glass; tins of sodium chlorate had previously stood on the site where the compost had been kept.

CYMBIDIUM In 1958, losses were high on a nursery in Bucks because of a rot of the pseudo-bulbs, and the fungus isolated was thought to be *Fusarium oxysporum* Fr. **Mosaic** (cymbidium mosaic virus) was often noted.

CYPRESS (Cupressus) There were one or two attacks of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer). Pycnidia of a species of *Phomopsis* were abundant in 1958 on bushes on a nursery in Cornwall, up to 15 per cent of which were yellowing and dying off.

CYPRIPEDIUM A species of *Rhizoctonia* caused **Foot Rot** on a Berks nursery in 1960.

DAHLIA **Leaf Spot** (*Entyloma dahliae* Syd.) (Plate XVI, 2) was commonly noted, and was heavy in several localities especially in Wales. Brady (*Trans. Br. mycol. Soc.* 1960, **43**, 31-50) studied the life cycle of this smut in detail. Sporidial forms are often associated with smut lesions but their significance has not been apparent. She proved that certain needle-shaped and allantoid sporidia are formed when chlamydospores of the smut germinate, and that needle-shaped sporidia are capable of reinfecting dahlias to form lesions and viable chlamydospores. However, her work shows that other types of sporidia belonging to *Itersonilia perplexans* and *Tilletiopsis washingtonensis*, which are commonly found associated with *Entyloma* lesions, and resemble sporidia of the smut superficially, are unlikely to have any connection with the life cycle of dahlia smut.

Grey Mould (*Botrytis cinerea* Fr.) and **Verticillium Wilt** (*Verticillium* spp.) were reported very infrequently, but **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) affected cuttings on a few nurseries. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was recorded on one or two nurseries in most years. Byford (*Pl. Path.* 1958, **7**, 38) examined wilting dahlia seedlings from a Scottish nursery. The wilt, with death of leaves, was associated with a stunted root system in these 6-10 in. high plants. Oogonia with oospores of *Phytophthora verrucosa* Alcock & Foister were found in affected roots. This was a new host record.

From 1957 to 1961, **Bacterial Rot** (*Pseudomonas marginalis* (Brown)

Stevens) was seen on a nursery in Northumb and on several in Wales. The disease, which had been recorded in Scotland, was described by Clark and Paton (*Pl. Path.* 1956, 5, 32-5). **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) was seen a few times in most years and was severe on a nursery in Berks, and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was noted sporadically.

Dahlia Mosaic virus was commonly seen in many areas. **Cucumber Mosaic** virus was severe in some stocks and symptoms of tomato **Spotted Wilt** virus were sometimes seen in the west of the country, but the latter seemed to be less frequently encountered in dahlias in the more recent years. Brunt (*Nature, Lond.* 1959, **183**, 627-8) reported what is thought to be the first record of tomato spotted wilt virus inducing enation formation in any of its known hosts. He also suggested that the oak-leaf, ring spot and yellow ring spot symptoms seen on dahlias in this country, and which can be caused by tomato spotted wilt virus, are identical with those originally said to be caused by certain supposedly separate and non-sap-transmissible viruses described in America as dahlia oak-leaf virus, dahlia ring spot virus and dahlia yellow ring spot virus, names which he thought might be invalid. Symptoms, similar to those recorded for potato (see p. 44) and attributed to **Lightning Injury** were seen on a holding in Middx.

DAISY **Foot and Root Rot** due to *Phytophthora cryptogea* Pethybr. & Laff., caused 5 per cent loss in several cultivars in Sussex in 1961. Plants with small distorted flowers and tubular florets were seen in Worcs in 1958 and a distorting virus was suspected.

DAPHNE The very common **Leaf Spot** (*Marssonina daphnes* Magn.) was reported occurring on fruit in Norfolk; and, in 1957, there was a record of **Verticillium Wilt** (*Verticillium* sp.) from the south-west. Cuttings being propagated under 'mist' in Berks in 1958 were severely affected by *Rhizoctonia* and the fungus severely damaged a batch of cuttings in the same Region in 1960. **Cucumber Mosaic** virus was mentioned in reports and is fairly general in this host, and **Alfalfa Mosaic** virus also was present on daphne in this country.

DELPHINIUM **Powdery Mildew** (*Erysiphe polygoni* Mérat) was heavy generally on crops from the market in Holland (Lincs) in 1959 and was very prevalent at one locality in Som the same year. Larkspurs at several places in the south-east and south-west were attacked by **Stem Rot** attributed to *Diplodina delphinii* Laskaris, and almost an entire larkspur crop in Holland (Lincs) failed because of an attack by *Diplodina passerinii* Allesch. on leaves and stalks. **Root Rot** (*Pythium* sp.), which has not often been found on *Delphinium* spp., attacked three stocks of larkspurs, and *Botrytis* was noted causing a stem rot in larkspurs. In 1961, **Foot Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) blackened and rotted the bases of cuttings in boxes of unsterilized loam in Som, and few roots were produced. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was recorded in Berks in 1958: it was the first time verticillium wilt had been found in delphiniums in this country. **Black Blotch** (*Pseudomonas delphinii* (Smith) Stapp) was reported on a number of occasions, while **Cucumber Mosaic** virus was seen in delphiniums and larkspurs and is fairly common in these hosts.

DIANTHUS (For florists' carnation see p. 156, and for sweet william see

p. 198). **Leaf Rot** (*Heteropatella valtellinensis* (Trav.) Wr.) and **Leaf Spot** (*Mycosphaerella dianthi* (Burt) Jørstad) were both noted in reports. Eighty per cent of the seedlings in a batch of 500 boxes of cv. Chabaud were infected by **Stem Rot** (*Alternaria dianthi* Stev. & Hall) in Surrey, about 20 per cent infection being found in the seed. The related fungus *A. dianthicola* Neerg. was not recognized on plants in this country until 1965, though it had long been known on the Continent. At Plant Pathology Laboratory, Harpenden, however, it was detected during this period, though in very small amounts, in two lots of mixed carnation seed of reputedly English origin. Severe **Foot Rot** (*Fusarium culmorum* (W. G. Smith) Sacc.) was seen in Devon on pinks in 1960, and leaf spotting caused by *Vermicularia herbarum* Westend. was noted in Glam in 1957. Both carnation **Vein-Mottle** and carnation **Ring Spot** viruses are common in border carnations.

DIERVILLA see Weigela.

DIMORPHOTHECA In 1959, **Verticillium Wilt** (*Verticillium* sp.) was found in specimens from Cornwall. This wilt has been reported twice before, on both occasions in Cornwall.

ECHINOCACTUS A basal rot due to a species of *Pythium* was reported in Yorks in 1958.

ELDER **Arabis Mosaic** virus has been confirmed, and the typical chlorotic vein banding and ring marking were seen at places in Worcs, War and Glos in 1959 and at two places in Brecon in 1960.

ELM Specimens of Berbers elm and Wych elm were attacked by **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

ERICA **Wilt** (*Phytophthora cinnamomi* Rands) was noted in Ches and on a number of nurseries in the south-east, various species of the host being involved. Losses were sometimes heavy. **Stem Rot** (*Phytophthora* sp.) appeared in a planting in the south-west in 1960. A **Die-back** of ericas, unconnected with parasites, is sometimes encountered and is probably due to unsuitable soil conditions.

EUCALYPTUS **Powdery Mildew** (*Oidium* sp.) was recorded for the first time in Great Britain in 1957 by Glasscock and Rosser (*Pl. Path.* 1958, **7**, 152). They found the disease in most of a batch of 500 seedlings of *E. perrineana* and 300 of *E. gunnii* in Kent and were able to control it with dinocap. Since then the mildew has been noted once each year in Cornwall, Ches or the Evesham area. Another first English record for this host was **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), fructifications of which were found on the trunks of three trees of *E. gunnii* growing out-of-doors in waterlogged soil in 1957 in Kent.

EUONYMUS The common **Powdery Mildew** (*Oidium euonymi-japonicae* (Arcang.) Sacc.) of *E. japonicus* featured in reports. Green and Brooks (*Jl R. hort. Soc.* 1959, **84**, p. 529) recorded some heavy attacks in 1959 on hedges.

FORSYTHIA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted in Glos in 1960, and **Foot Rot,** attributed to *Rhizoctonia* sp. caused severe damage in a batch of cuttings in the South-eastern Region.

FREESIA **Botrytis Rot and Grey Mould** (*Sclerotinia draytonii* Buddin and Wakef. and *Botrytis cinerea* Fr.) were prevalent in the south-east in 1958 and 1959, and frequent in the south-west in 1959. Substantial losses

in Hants in October 1959 from leaf spotting and stem rot were due to *S. draytonii*. *Botrytis* was locally significant, and on occasions severe, in some other areas during the five-year period and was responsible for spotting of the flowers in some crops. Several attacks of **Yellows** (*Fusarium oxysporum* Fr. f. *gladioli* (Massey) Snyder & Hansen) were reported each year, with a few heavy losses. In the extreme south-west it was fairly common in both 1960 and 1961, and often serious in the latter year. In Dorset, **Foot Rot** in a crop was associated with a species of *Fusarium* in 1961. **Dry Rot** (*Sclerotinia gladioli* Drayt.) was quite damaging, and was common in parts of the south-west in 1960 and 1961. In the odd attack, although roots were rotted by the fungus, the corms appeared to be undamaged. A species of *Pythium* was responsible for three outbreaks of **Root Rot** in the South-eastern Region. *Heterosporium gracile* Sacc., the conidial stage of **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst., had affected some specimens received from Berks in 1959. This fungus, the causal agent of iris spot leaf has previously been recorded on gladiolus and schizostylis.

Scab (*Pseudomonas marginata* (McCulloch) Stapp) was noted. Freesia **Mosaic** virus, which produces no symptoms in many cultivars, was recorded a few times; symptoms (Plate XI, 3) were common in the Eastern Region in 1959, particularly on cv. White Cream. Symptoms caused by **Bean Yellow Mosaic** virus have been noted in a few crops and the disease is common. The virus often causes flower breaking; it is prevalent in Holland and was isolated from freesias in Britain at Plant Pathology Laboratory, Harpenden. In April 1958, flowers were failing to open properly on a holding in Dorset and inflorescences were malformed. Loss of blooms amounted to 10 per cent and symptoms were attributed to this virus. **Blindness** was associated with high temperature at bud initiation in a crop in Oxon.

In an attempt to stop the spread of *Botrytis* in freesia crops in the Starcross Sub-Region the plants were sprayed with captan. This apparently caused damage at a concentration of 4 oz/2 pints in a paint spray gun worked off a compressor. A white necrotic pattern appeared over the leaf surfaces in areas of the crop where the gun had been directed at the foliage. A white tipping of some leaves, extended up to 6 in. down the lamina. The fungicide at $\frac{1}{2}$ oz of 50 per cent wettable captan per gal, applied as a drench to freesias in pots (32's), at $\frac{1}{2}$–1 pint per pot, caused some similar damage.

FUCHSIA The rather uncommon **Rust** (*Pucciniastrum epilobii* Otth) was seen on a few occasions, and **Grey Mould** (*Botrytis cinerea* Fr.) was responsible for die-back following stopping and removal of shoots for cutting on a nursery in War.

GARDENIA Non-parasitic **Bud Drop** was noted on plants on an Oxon nursery in 1959. In the U.S.A., bud drop, which can apparently be associated with a wide range of factors is a big problem in gardenia culture.

GENTIAN **Leaf Blight** (*Pycnothyrium gentianicola* Grove) was responsible for fairly extensive foliage death in some plants of *Gentiana sino-ornata* in Devon in 1958. It has previously been recorded from Cornwall (1948), and there have been a few records from Scotland.

GERANIUM see Pelargonium.

GERBERA This host is susceptible to a number of diseases, and **Crown**

and Root Rot (*Phytophthora* spp.) is one of the most troublesome. Infection has usually been attributed to *P. cryptogea* Pethybr. & Laff. Attacks have been investigated in Lancs, the Lee Valley and Sussex. Half the plants in 1,000 sq. ft were infected in one attack on a site where the rot had first been confirmed the previous year. **Powdery Mildew** (*Oidium* sp.) was first recorded in England and Wales in 1957 when Miss E. R. Schofield found the disease at Luddington Experimental Horticulture Station, War. It was again noted there in 1958. First records have also been made of **Verticillium Wilt** (*Verticillium* spp.). In 1958, A. G. Walker isolated *V. alboatrum* Reinke & Berth. from wilting plants, with discoloured vascular tissues of stem and roots, collected at Luddington. *V. dahliae* Kleb. was isolated from the crowns of affected plants in Hants in 1959.

Botrytis can be troublesome in gerberas. The use of captan for controlling it in plants grown in cold structures with or without mulches of peat or gravel was tried (*Rep. Luddington exp. Hort. Stn, 1960*, 66) but differences between the treatments were not significant in the three years of the experiment. A species of *Fusarium* was isolated from specimens with **Root and Foot Rot** on a Herts nursery in 1959, while *Rhizoctonia* sp. was associated with a crown rot of a plant in Hants in 1958. Tomató **Spotted Wilt** virus was confirmed on plants at Luddington E.H.S. in 1959, and line pattern symptoms suspected to be caused by a virus were seen in War in 1957.

GEUM In 1958, specimens with **Green Flowers** from War were considered by East Malling Research Station to be infected with the green petal virus (clover phyllody virus) of strawberries, and similar symptoms were present in several plants in a stock of the red cultivar Mrs. Bradshaw in Oxon the same year, but were absent in an adjacent yellow cultivar.

GLADIOLUS The damaging **Botrytis Rot and Core Rot** (*Sclerotinia draytonii* Buddin & Wakef. and *Botrytis cinerea* Fr.) was prevalent in the south-west in 1958 and 1959, and during the five years caused severe spotting of leaves and rotting of corms in nurseries in many parts of the country. It was the most troublesome disease of gladiolus. On a nursery in Sussex, where leaves of many cultivars were badly spotted by *B. cinerea* in 1958, symptoms were reproduced when a spore suspension was sprayed onto healthy plants. Good control on a small scale was obtained by Francis (*Gdnr's Chron.* 1957, **142**, 93) when corms, with husks intact, were shaken in a tin with tecnazene powder at lifting time **Fusarium Yellows and Fusarium Rot** (*Fusarium oxysporum* Fr. f. *gladioli* (Massey) Snyder & Hansen) was common in the Eastern Region in 1959 and also, with several instances of serious loss, in Devon and Cornwall in 1960 and 1961. The storage rot, caused by this fungus, was occasionally heavy. In the extreme south-west, yellows was said to be the most troublesome disease of *Gladiolus nanus*, cv. Peach Blossom appearing to be particularly susceptible. All new stocks at a nursery in Pemb in 1960 had root rot, attributed to *Fusarium* spp. and accompanied by yellowing, dwarfing and stunting. Commonly seen, **Dry Rot** (*Sclerotinia gladioli* Drayt.) badly attacked some crops: in one attack in the east Midlands, infection was severe on the roots. Interest was being shown in soil treatments against this disease. **Hard Rot and Leaf Spot** (*Septoria gladioli* Passer.), on the other hand, appeared to have caused only a few bad losses. Stone (*Trans. Br. mycol. Soc.* 1958, **41**,

508-18) studied the infection cycle and considered what lines of investigation on control measures might profitably be followed in future. She also discussed the origin of the disease and its geographical distribution.

Root Rot, killing plants in a crop of cv. Allard Pearson in Cumb in 1960, was attributed to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. The fungus was also associated with rot of several corms in a small consignment from the U.S.A. Specimens from Bucks in 1960 had distorted and chlorotic dwarfed foliage, and a species of *Pythium* developed profusely on the rotted roots: the primary trouble was waterlogging in heavy soil. In Sussex, a fungus agreeing with *Phytophthora cactorum* (Leb. & Cohn) Shröt. was isolated from stem lesions, about 2 in. above the corm, on a few foot-rotted plants, 9 in. high, in Sussex. **Smut** (*Urocystis gladiolicola* Ainsw.) was identified on a plant from a Dutch corm in Bucks in 1959.

Half of an outdoor batch of plants in Kent in 1957 was affected by **Scab and Neck Rot** (*Pseudomonas marginata* (McCulloch) Stapp), which otherwise gave little cause for concern. **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) appeared on a few plants of a stock in Northumb in 1960.

Symptoms attributable to virus infection were not uncommon in gladiolus but could not always be related to specific viruses. Usually encountered were slight chlorotic leaf spotting often associated with **Bean Yellow Mosaic** virus, and prominent yellow rings, or ring and line patterns which have been associated with both **Tobacco Ring Spot** and **Pea Mosaic** viruses. **Cucumber Mosaic** virus was also known to occur causing poor quality flowers (Plate XI, 2). Few confirmed reports were received however. Bean yellow mosaic was confirmed in a crop in Beds in which nearly 80 per cent of the plants had grown poorly and were chlorotic; the corms were from Holland.

Browning (non-parasitic) was frequent in parts of the north in 1957, 1959 and 1960. In 1960, contractile roots completely failed to develop during a drought period in early summer and browning was exceptionally frequent and often severe in places. It was very common in the South-eastern Region in 1957 and in the Eastern Region in 1959; and in 1960 cv. Aguita was affected on a number of nurseries in War.

Plants in a crop in Som in 1961 were slightly stunted with a severe flecking on the leaves. The symptoms were prevalent particularly on cv. Alfred Noble. There was no flower break, and leaf symptoms were similar to those of virus infection in freesias. The trouble was believed to be due to **Zinc Toxicity** following applications of zinc-contaminated sewage sludge.

GLOBE FLOWER In 1959, **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was newly recorded on *Trollius*, when infection occurred in a patch of mother plants from which cuttings had been taken in Ches.

GLOXINIA see Sinningia.

GODETIA **Wilt** (*Diplodina passerinii* Allesch.) was recorded in the east Midlands in 1957. This disease was first described by Taylor (*Ann. appl. Biol.* 1941, **28**, 91-101) and had only been reported once in the interval since. An outbreak of **Damping-off** (*Pythium* sp.) was very well controlled by a thiram seed dressing in Mon in 1957. *Pythium* had not been noticed on this host before.

GORSE An attack of **Armillaria Root Rot** (*Armillaria mellea* (Fr.)

Kummer) reported from Cards in 1960 appeared to be a new host record for this country.

GYPSOPHILA A species of *Phytophthora* agreeing with *P. megasperma* Dreschl. was isolated by E.T. Roberts in 1958 from the crowns of cv. Bristol Fairy grown in waterlogged soil on a nursery in Hants. No other previous records of *Phytophthora* on this host have been found for this country. In November 1958, 10-12 per cent of 2-year old stocks of cv. Flamingo, bought in from Surrey, were affected by **Sclerotinia Rot** (*Sclerotinia serica* Keay) in an open frame in Flints. The infection had apparently given trouble during the two previous years, and had been attributed by the grower to flooding, though 1-year plants from pots had remained healthy. The trouble began each year when the propagated material was set out in the field to grow on for one year to sell at 2-years old. It is assumed that the plants were infected when delivered in Flints. This rot had been found previously in the field only in Beds, where it was originally recorded (see Moore, *Bull. Minist. Agric. Fish.* No. 126, 1944, p. 85).

HAWTHORN **Rust** (*Gymnosporangium clavariiforme* (Pers.) DC.) was prevalent on trees on a Dorset estate, and nearby junipers bore the alternate stage. This was a new record for the Region. The rust was noted also in Kent. Perithecia of a species of *Nectria*, resembling *N. galligena* were associated with die-back of twigs on several shoots from a hedgerow in Sussex, and *Nectria* sp. was isolated from cankers on a specimen in the South-eastern Region. The common **Powdery Mildew** (*Podosphaera oxyacanthae* (DC.) de Bary) gave rise to many complaints of bad attack in 1959 (Green and Brooks, *Jl R. hort. Soc.* 1959, **84**, p. 529). It caused severe damage in one or two other reported cases: while a disfiguring outbreak of **Leaf Blotch** (*Monilinia johnsonii* (Ell. & Ev.) Honey syn. *Sclerotinia crataegi* Magn.) was seen in a garden in Som in 1960 and 1961, and the disease was seen in hedgerows in the neighbourhood (Bond, *Trans. Br. mycol. Soc.* 1961, **44**, 613-4). **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) first appeared on this host in 1959 (Billing *et al.*, *Pl. Path.* 1959, **8**, 152) and severe infection has been common since. Shoots have been frequently infected and the bacterium survives the winter in the trees. Gardens, parks and road-sides in the Greater London and Southend-on-Sea (Essex) areas have been extensively affected. *Crataegus oxyacantha* and *C. monogyna* have been attacked.

HELENIUM In 1957, **Verticillium Wilt** (*Verticillium* sp.) occurred in some plants in Salop. *V. dahliae* Kleb. has once been recorded in heleniums. Two dozen plants on a Sussex holding were all affected by **Clover Phyllody** virus when examined in 1958; the infection being confirmed at East Malling Research Station. These plants had been raised from three of the previous year's stock, in which no symptoms were visible. Infection of helenium was obtained by Posnette and Frazier (*Ann. appl. Biol.* 1957, **45**, 580-8) and symptoms were illustrated in their paper. Natural infection has been seen on one or two other occasions and the disease may be locally common.

HELLEBORE **Leaf Spot** (*Coniothyrium hellebori* Cooke & Massee) has been fairly frequent, particularly in the north in 1959 and 1960, and quite heavy in a few places in various parts of the country. It is sometimes seen

in imported plants. Rotting of leaf bases was associated with *Pythium* sp. and *Rhizoctonia* sp. on a nursery in Cumb in 1961.

HEMEROCALLIS The central shoot of an occasional plant on a nursery in Berks in 1958 was completely rotted by a species of *Pythium*, the roots remaining healthy.

HESPERIS *Rhizoctonia* sp. was associated with **Damping-off** of a batch of sweet rockets in Ches in 1958.

HEUCHERA A record of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) came from Ches in 1959.

HOLLY **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted once. **Leaf Spot and Die-back** associated with *Phomopsis crustosa* Trav. was recorded in the South-western Region in 1961. Various records of this fungus on dead twigs and leaves are recorded by Grove (*Br. Coelomycetes*, **1**, pp. 192-3).

HOLLYHOCK In 1958, **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was found attacking hollyhocks near Peterborough—apparently a new host record. **Rust** (*Puccinia malvacearum* Mont.) is widespread. Hollyhock **Mosaic** virus occurs in this host.

HORNBEAM *Phomopsis sordidula* (Sacc. & Syd.) Trav. was found on dying branches in Bucks in 1961 (Batko, *Trans. Br. mycol. Soc.* 1965, **48**, 148-9).

HYACINTH **Bulb Rot** (*Penicillium* sp.), **Root Rot** (*Pythium* sp.) **Yellow Disease** (*Xanthomonas hyacinthi* (Wakker) Dowson) were infrequently noted, but **Soft Rot** (bacterial) was sometimes troublesome particularly on forced plants. In 1961, **Tobacco Rattle** virus was confirmed by inoculations from some plants of cv. City of Haarlem, raised from Dutch bulbs. Stunting, chlorotic leaf streaking and a slight necrotic flecking in the bulbs were present, about 10 per cent of 2,000 plants being affected: the eelworm *Trichodorus* could not be detected in the soil. Also known to occur in hyacinths was **Bean Yellow Mosaic** virus.

In 1958, some very interesting specimens with symptoms agreeing with **White Slime and Gummosis** (cause unknown) were received from a merchant in Birmingham. Moore described the disease in *Diseases of Bulbs* (*Bull. Minist. Agric. Fish.* 117, 1939, pp. 9-10). Prepared bulbs of cvs. Pink Pearl, Delft Blue, Yellow Hammer and Jan Bos had been on show in a shop window, and had become sticky, exuding a frothy substance. Early symptoms were noted in unprepared bulbs of Jan Bos not exposed to the conditions of heat etc. in the window but kept on shelves in the warehouse. There had been no trouble with displayed bulbs in previous seasons, but the merchant had noticed the stickiness on a number of bulbs, both prepared and unprepared, in bins in the shop. The bulbs were of Dutch origin. **Loose Bud** (non-parasitic) caused some losses; and various forms of **Preparation Injury** were recorded, including lack of roots and death of florets.

HYDRANGEA The disfiguring **Powdery Mildew** (*Microsphaera polonica* Siemaszko) appeared in a number of reports, and the rare **Leaf Spot** (*Septoria hydrangeae* Bizz.) was moderate on a nursery in Caerns in 1961, last being recorded in this country in 1929. *Rhizoctonia* sp. affected one lot of cuttings in Yorks W.R.; and **Grey Mould** (*Botrytis cinerea* Fr.) was noted. Hollings has investigated the host range and properties of hydrangea **Ring Spot** virus (*J. hort. Sci.* 1958, **33**, 275-81). It is probably

common and has been seen in the Midlands, the south-east and south-west and in plants imported from Holland. Death of a garden bush in Anglesey was caused by **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

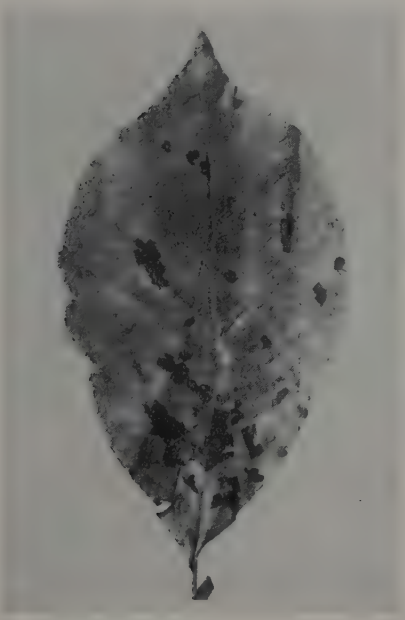
HYPERICUM A new host record of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) came in 1960, from Devon.

IRIS **Grey Mould** (*Botrytis cinerea* Fr.) was reported causing severe flower spotting in one or two crops only. Infected leaves of *Iris germanica* were received from Surrey in 1961. **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was occasionally reported, and the fungus appeared to be causing a stem rot in several cultivars of bulbous iris in Kesteven (Lincs), in 1960. **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst.) was common in the extreme south-west in most years and often associated with weather damage and flower failure. Some attacks were serious. Sprays of maneb and zineb showed promise of control. Lesions of bulbs of *Iris reticulata* were noted in a house-produced stock in Cornwall, and the fungus was isolated. Dark rusty areas with a darker margin were usually on the top half of the bulbs only; the reticulate scales and occasionally the fleshy scales were also infected. A severe attack on some cultivars in a cultivar collection of *I. germanica* occurred in Northumb.

Imported bulbs can be very heavily infected with **Fusarium Bulb Rot** (*Fusarium oxysporum* Fr. f. *tulipae* Apt), and 1958 saw more than usual in bulbs going into Holland (Lincs). Of one batch of several hundred thousand cv. Wedgwood bulbs from Malta, grown in Lincs in the 1957/8 season, over half were said to be affected. Slight infections may affect one side of the bulb, the plant then failing to grow vertically and may even grow horizontally. The disease, though known in the U.S.A., had not previously been recognized as such here. According to the late J.O. Page some growers previously attributed this type of growth to flat-sided bulbs which consequently were not favoured by forcers. However, in an evenly infected stock, Page found that more infected plants were found in the round 10 cm bulbs than in the 8-10 cm sizes. This trouble was noted in Bucks in 1959 and Cornwall in 1961. Fusarium rot of iris bulbs imported into Guernsey has been described by Harrison (*Pl. Path.* 1958, 7, 16-8). An attack of **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was confirmed in Lincs, the third time the fungus has been recorded on irises. **Ink Disease** (*Bipolaris iridis* (Oudem.) Dickinson syn. *Mystrosporium adustum* Massee) was more common than usual in the Starcross Sub-Region in 1958, the worst affected cultivars being Wedgwood and Imperator, but otherwise was not often noticed.

Bulb Rot (*Penicillium* spp.) is sometimes heavy in imported consignments. Sometimes *Penicillium* is confined to the outer skin but, with the progressive form of rot, a species similar to *P. corymbiferum* Westl. is often encountered. This type of rot was discussed by Moore (*Diseases of Bulbs, Bull. Minist. Agric. Fish.* 117, 1939, pp. 135-6). **White Root Rot** (*Rosellinia necatrix* (Hartig) Prill.) was present on some rotting bulbs in Isles of Scilly in 1960. **Grey Bulb Rot** (*Sclerotium tuliparum* Kleb.) was noted several times. Symptoms like those of grey bulb rot were observed on specimens from a nursery in Lindsey (Lincs) in 1958 but there was no rotting of the neck or bulb, and symptoms were confined to the above-ground

1. Chrysanthemum flowering stems affected by ray blight (*Mycosphaerella ligulicola*) (pp. 161, 271).



2. Magnolia leaf with leaf spot (*Pseudomonas syringae*) (p. 186).

3. Leaves on azalea shoot showing gall (*Exobasidium vaccinii*) (pp. 193, 296).

PLATE IX

1. Antirrhinum plants with leaf spot (*Phyllosticta antirrhini*) (pp. 169, 275).

2. Acidanthera corms affected by, and bearing sclerotia of, *Botrytis gladiolorum* (p. 167).

PLATE X

parts: sclerotia of **Crown Rot** (*Sclerotium delphinii* Welch) developed on incubated foliage. Bulbs and leaves of cv. Yellow Queen were attacked by this fungus in February 1960 on a nursery in Devon. *S. delphinii* was previously recorded in English iris bulbs in 1932. **Soft Rot** (bacterial) has been seen on rhizomatous irises from time to time. Severe **Mosaic** (iris mosaic virus) symptoms were commonly noted in the south-west in 1960 and 1961. The virus is very frequent in bulbous irises.

Scorch (non-parasitic) was reported as troublesome again in several gardens in the east Midlands in 1960; and cases of **Blindness** occurred in some seasons, including considerable losses in cv. Wedgwood on a number of holdings in the South-eastern Region in 1959. An iris disorder very similar to **Topple** (non-parasitic), first described in the U.S.A. (Haasis, *Pl. Dis. Reptr*, 1953, **37**, 558-9) occurred in plants on a nursery in Devon in March 1959. As with topple in tulips, the stem collapsed at a point below the flower, following a deterioration of the tissues there. **Frost Injury** was frequently seen in Devon in April 1958.

Gillow and Siddal (*Grower*, 1957, **48**, 130-3) surveyed several kinds of failure in cooled iris bulbs which occurred in Guernsey in 1956 and 1957. These included a three-leaf condition and a related trouble, bud blast, which were both particularly serious in 1957. Incorrect preparation and the forcing of bulbs too small for the purpose are responsible for these conditions.

ISOLOMA The physiological **Ring Spot,** described by Hollings (*Pl. Path.* 1955, **4**, 123-8) on other members of the Gesneriaceae, was seen on *Isoloma* in Worcs..

IXIA Flower spotting due to *Botrytis* sp. caused considerable losses in 1957 on a holding in Cornwall.

JUDAS TREE There have been two new records on *Cercis siliquastrum*, **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), which was noted in Som in 1957, and **Verticillium Wilt** (*Verticillium dahliae* Kleb.), which had affected specimens from a garden in Worcs in 1958. No earlier records of *Verticillium* on Judas tree in this country were traced, but isolates considered identical with *V. alboatrum* had been reported on the host in Italy.

JUNIPER **Rust** (*Gymnosporangium clavariiforme* (Pers.) DC.) teleutosori were seen in Dorset in 1959, the alternate stage being prevalent in nearby hawthorns.

KALANCHOE **Powdery Mildew** (*Erysiphe* sp.) has been seen in Norfolk and at Fairfield Experimental Horticulture Station, Lancs where it did severe damage. This mildew was described by F. J. Moore in *Pl. Path.* 1952, **1**, 53-5, and was then considered probably to be *E. polyphaga* Hammarl. On a nursery in War in 1960, *Botrytis* sp. was extensive on roots, stem bases and lower petioles; and sclerotia were abundant on all affected parts, some of the lateral roots being completely ensheathed. Sclerotia produced abundant conidia on culture media.

KERRIA In Herts, in 1958, foliage of a bush of a double cultivar of *Kerria japonica* showed silvering due to **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.)—a new host record.

LABURNUM **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was found to be attacking a tree in Hants in 1960, and an occasional attack of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was reported. **Mosaic**

(laburnum mosaic virus), (Plate XV, 2), was known to be quite common in this host.

LARKSPUR see Delphinium.

LAVENDER There were a few records of **Shab** (*Phoma lavandulae* Gabotto), including much damage in the lavender of the perfume industry at Caldy Island, Pemb. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted.

LEYCESTERIA **Cucumber Mosaic** virus was found in a plant of *Leycesteria formosa* by Hollings (*Rep. Glasshouse Crops Res. Inst. 1960*, 78).

LIATRIS *Verticillium* sp. was associated with a crown rot of plants in frames in Yorks W.R. in 1961.

LILAC *Botrytis* sp. caused **Die-back** in a few instances, and *B. cinerea* Fr. was said to have caused an extensive rot and early leaf fall in Denbigh in September 1958. **Leaf Spot** (*Phyllosticta syringae* Westend.) affected numerous cuttings in a frame in Kent in 1961 and *Rhizoctonia* sp. severely affected cuttings being propagated under 'mist' on a nursery in the south-east in 1958 and 1960. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) have both been observed. Isolations from blackened shoots, stated to be typical of 30 per cent of 600 trees in Surrey in 1960, showed **Bacterial Blight** (*Pseudomonas syringae* van Hall) to be present. A ring spot type virus has been noted.

LILY **Black Scale** (*Colletotrichum lilii* Plakidas) was identified by L. Ogilvie on bulbs of *Lilium longiflorum giganteum* received from a nursery in Bath in 1961. The bulbs had been imported in October 1960 from Japan. This is the only known occurrence of the disease in this country. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was recorded in a Bristol garden in 1959: past records of this fungus on bulbous hosts are very few. **Lily Disease** (*Botrytis elliptica* (Berk.) Cooke) was severe on three nurseries in the south-east, and **Grey Mould** (*Botrytis cinerea* Fr.) developed severely in 1960 in Norfolk on the leaves of Madonna lilies grown for cut flowers. **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was damaging in one or two instances and, with a species of *Pythium*, caused failure in one house in Denbigh. *Rhizoctonia* was associated with reddish-brown lesions on the stems of some *Lilium longiflorum* plants in the south-west. During 1958, consignments of bulbs from Japan arrived with severe **Penicillium Rot.** The characters of the fungus agreed with those of *P. cyclopium* Westl., previously noted in imported lilies. *L. auratum* was the species worst affected, and in some boxes up to 70 per cent of rotting bulbs was found. The same disease has been found in a few other Japanese consignments. **Cucumber Mosaic** virus, and **Rosette Disease** (lily rosette virus) on Easter lilies in Som, from bulbs originating in Japan, were noted.

LILY-OF-THE-VALLEY **Leaf Spot** (*Botrytis sp.*) was recorded in 1959 and 1961, and was severe on one occasion in Cornwall. In one instance rotting of the 'pip', with various saprophytic fungi present, was associated with hot water treatment immediately after removal from cold storage.

LIME Death of a large proportion of young trees in the South-eastern Region in 1960 was associated with *Verticillium dahliae* Kleb., the fungus being isolated from brown-stained wood. *V. dahliae* had not previously been reported on *Tilia* in this country.

LOBELIA An attack of **Leaf Spot** on seedlings in Som in 1957 was attributed to *Alternaria alternata* (Fr.) Keissler (syn. *A. tenuis*). Wilcox later recorded the leaf spot in Kent (*Pl. Path.* 1963, **12**, 137-8). **Damping-off** by *Botrytis* and by *Pythium* sp. was noted. **Cucumber Mosaic** virus was reported to occur in this host.

LONICERA Of interest was a record of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) from Bristol in 1960. **Cucumber Mosaic** virus occurs in *Lonicera*, and the vein clearing virus on *L. japonica* illustrated by Schmeltzer (*Phytopath. Z.* 1963, **46**, p. 106) has been known for some time in this country.

LUPIN **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) has been seen a few times. **Leaf Spot** (*Pleiochaeta setosa* (Kirchn.) Hughes) was recorded in Sussex and Glos, and caused considerable damage on a nursery in Flints. **Violet Root Rot** (*Helicobasidium purpureum* Pat.) appeared on a nursery in Hunts in 1957—a new host record, and near Peterborough in 1958. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. had previously caused no noticeable trouble in lupins but was responsible for a few cases of **Stem Rot** or **Root Rot** during these years. On a nursery in Berks, loss of cuttings and stools due to the fungus was serious in March 1958, after the stools were bedded out late in 1957; and about 15 per cent were dying off with a stem rot in a large patch of plants in whalehide pots in open frames in Surrey in 1959. Stem rot was noted also in Cumb: root rot was extensive in plants on a nursery in Ches and a weft of *Corticium* was present on above ground parts.

Viruses were at this time known to be a problem in lupins, and it was suspected that a number of different viruses was involved. Widespread and severe infection caused heavy losses to a range of cultivars on a nursery in Salop and some were stated to have been killed out. **Cucumber Mosaic** virus had been diagnosed there previously and this or some other virus may have built up. The plants were stunted and bore dark markings on mature leaves and vein banding on younger foliage. Symptoms were similar on a nursery in Ches in 1960 where nearly every one of 200 plants of cv. Heather Glow was killed, and City of York was also substantially infected. Cucumber mosaic virus was isolated from plants with 'sore shin' in Berks in 1960, and symptoms were seen on a nursery in N. Wales in 1961. Howles and Hollings (*Rep. Glasshouse Crops Res. Inst. 1959*, 72) noted virus-like symptoms in nearly all the lupins in the trial at the Royal Horticultural Society's gardens, Wisley in 1959. They detected both **Alfalfa Mosaic** and **Pea Mosaic** viruses. Pea mosaic virus was confirmed in a few plants of cv. Mrs Sarah Buttfield in Surrey in 1961, and there were symptoms attributable to **Clover Phyllody** virus in Russell lupins in a garden in Cards in 1960. Tomato **Spotted Wilt** virus was occasionally found. **Bean Yellow Mosaic** and several other viruses from legumes can infect lupins. Most appear to cause leaf mottling and reduced vigour, sometimes with necrosis.

MAGNOLIA In 1961, 10 per cent of the buds of 30 *Magnolia stellata* plants on a nursery in Sussex showed internal blackening, and pycnidia of a species of *Ascochyta* were present on 50 per cent of the buds. *Rhizoctonia* sp. caused rotting of cuttings being 'mist' propagated on a nursery in the

south-east in 1958 and 1960. Imported plants occasionally showed **Leaf Spot** (*Pseudomonas syringae* van Hall) (Plate IX, 2).

MALOPE *Colletotrichum malvarum* Southw. was recorded in Yorks E.R. in 1957—apparently a new host record for this country. This fungus is occasional in *Lavatera*.

MAPLE In 1959, infection by **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was confirmed in a 2-year old tree of mountain maple (*Acer spicatum*) in Worcs, one of a dozen which had died back after making good growth in 1958. The affected trees were on heavy soil with locally impeded drainage. *V. dahliae* was isolated in 1958 from roots and stems of 1-year budded *A. platanoides* cv. Goldsworth Purple which had failed to grow in Surrey, and it was also confirmed the same year in stocks of *Acer* spp. on two nurseries and in a single infected ornamental *Acer* in a garden in Worcs. *V. dahliae* and *V. alboatrum* are known to cause wilt in sycamore and other maples (Peace, *Pathology of Trees and Shrubs*, p. 409). On one occasion, **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found attacking a species of *Acer*. **Acer Variegation** virus seemed common on several species. See also Sycamore.

MARGYRICARPUS Infection by **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was confirmed in a specimen of *Margyricarpus setosus* from Kent in 1957. This was a new host record.

MARIGOLD (*Tagetes*) **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was found on two holdings in 1960, in Lancs and the south-east respectively. **Foot Rot** (*Phytophthora* sp.) was severe in a bed in Kent in 1957.

MESEMBRYANTHEMUM **Damping-off** (*Pythium* sp.) was observed in War.

MICHAELMAS DAISY In the East Midland and Eastern Regions in 1959, and in Glos in 1961, **Powdery Mildew** (*Erysiphe cichoracearum* Mérat) was particularly widespread and severe. A number of other heavy attacks of this common disease were reported. **Verticillium Wilt** (*Verticillium vilmorinii* (Guég.) Westerd. & van Luijk) was said to be prevalent in Staffs in 1957, and was quite frequent in other areas and years. Since 1957, *V. dahliae* Kleb. has been isolated from wilted stocks in the south-east, and twice in Worcs. It was involved in the death of 20 per cent of one batch of plants in Surrey. An interesting record was the occurrence in 1958 of mycelium of a Basidiomycete on blooms showing symptoms similar to those of **Flower Scorch** (*Itersonilia perplexans* Derx) in chrysanthemums, which were also attacked on this nursery in War. In 1958, **Foot Rot** (*Phytophthora* spp.) attacked some plants in Bristol, while *P. cryptogea* Pethybr. & Laff. killed patches of bedding seedlings in boxes in Kent, and large patches in Dutch light frames in Bangor, where plants wilted just before flowering. *Phytophthora* spp. have not been mentioned in reports on michaelmas daisy previously. Tomato **Aspermy** virus has been observed in this host.

MONTBRETIA see Tritonia.

MOUNTAIN ASH see Rowan.

MUSK-PLANT **Fusarium Wilt** (*Fusarium* sp.) was noted on *Mimulus moschatus* in N. Wales in 1959. This disease has not previously been noted in *Mimulus* in this country.

MYOSOTIS **Powdery Mildew** (*Erysiphe cichoracearum* Mérat) was occasionally severe.

NARCISSUS **Smoulder** (*Sclerotinia narcissicola* Greg.) was troublesome in some stocks, but apart from the bulb areas of the Eastern Region, where it was general at times, bad attacks were not particularly frequent. *Botrytis cinerea* Fr. sometimes affects leaves and flowers. **Basal Rot** (*Fusarium oxysporum* Fr. f. *narcissi* Snyder & Hansen) was mainly damaging in the 1958 and 1959 planted crops and, with a number of attacks, infection ranged from 20 to 75 per cent: in Devon and Cornwall it was above average early in 1960. As usual, cvs. Carlton and Golden Harvest were among the most heavily affected. Infection was barely noted in reports throughout 1957.

Generally troublesome in most years in the Starcross Sub-Region and the Isles of Scilly, **Leaf Scorch** (*Stagonospora curtisii* (Berk.) Sacc.) was much more prevalent than usual in the springs of 1957 and 1958 in the Isles and in W. Cornwall, especially in cvs. King Alfred and Helios, and in 1959 in the Isles where it is always a problem on the early cv. Soleil d'Or. Above-average attack was experienced in the Starcross Sub-Region in 1961 too. The disease was seen in many other areas but was not usually of much consequence in them. It was, however, more prevalent than usual in S. Wales in spring 1958. The efficiency of various fungicides for the control of leaf scorch was tested by Smith and Smith (*Rep. Glasshouse Crops Res. Inst. 1960*, 83), who also studied some biological aspects of the fungus (ibid. *1961*, 83).

White Mould (*Ramularia vallisumbrosae* Cav.) was troublesome in all years in the Starcross Sub-Region. It was prevalent in the Isles of Scilly early in 1958 in spite of cold weather; by April, infection was more than usual and much foliage died prematurely. Attacks in the Isles were frequent also in 1961. All of a 3-acre crop was fairly badly attacked in Anglesey the same year—the first time white mould had been seen in N. Wales. Growers in the Isles of Scilly have been concerned about an increase of **White Root Rot** (*Rosellinia necatrix* Prill.): the effect of soil treatments was being investigated. Losses caused by **Fire** (*Sclerotinia polyblastis* Greg.) were often heavy in Isles of Scilly, and to rather less extent in Cornwall, in the three seasons 1959-61. Rhizomorphs of *Armillaria mellea* (Fr.) Kummer were seen between the scales of a bulb in Cornwall. Both *Pythium* sp. and *Nectria radicicola* Gerlach & Nilsson (syn. *Cylindrocarpon destructans* (Zins.) Scholten) were isolated from bulbs from a few boxes in which the roots had died just before flowering on a holding in Holland (Lincs). The secondary fungus, *Ophiostoma narcissi* Limber, first reported in this country by Baker (*Pl.Path.* 1954, **3**, 29) has been seen from time to time on bulbs affected by primary pests and parasites. The apparently harmless **Scale Speck** mentioned by Moore (*Bull. Minist. Agric. Fish. Lond.* No. 117, 1939, p. 91) is not uncommon on narcissus bulbs. No apothecia are known in Britain but Dennis (*Mycol. Pap.* 1956, No. 62, pp. 160-1) has referred to a scale-speck fungus here as *Stromatinia narcissi* Drayton & Groves. Rotting of the tips of leaves by **Soft Rot** (bacterial) affected a whole crop in Devon following flame gunning of the beds.

Narcissus **Mosaic** and narcissus **Yellow Stripe** viruses are common in stocks. Broadbent *et al.* (*Jl R. hort. Soc.* 1957, **82**, 395-401) have

considered the particular problem with viruses in the narcissus trials at the Royal Horticultural Society's gardens, Wisley.

In 1961, positive results for **Arabis Mosaic** virus were obtained when inoculations from leaves and roots of cvs. Soleil d'Or and King Alfred plants were made to standard indicator plants, by P. Wiggell in the Starcross Sub-Region. The eelworm vector, *Xiphinema diversicaudatum*, was recovered from soil in which the bulbs had been growing. Further infections were confirmed in the Isles of Scilly in the same year. **Tobacco Rattle** virus was confirmed in several lots of plants, also in the Scillies, in 1960 and 1961. Cultivars were King Alfred, Soleil d'Or and Unsurpassable, and the eelworm vector *Trichodorus* was found in soil from the site in a few cases. Further examination of narcissus crops showed that arabis mosaic virus, and to a lesser extent tobacco rattle virus, were common in the Scillies and fairly common in W. Cornwall. Symptoms also noted in crops infected with the above viruses were a severe mottle and chocolate-coloured necrotic streaks in Soleil d'Or and a hard leaf tipping in King Alfred.

An unusual form of spotting on the petals of plants in the Holbeach-Spalding bulb areas was drawn to the attention of advisers for a few seasons after it was first seen in 1955. It was thought possibly to be due to fumes from low-flying aircraft, and an account of the trouble appeared in *Comml Grow.* 12 April 1957, p. 753. **Scale Regression** was present in a number of stocks, mainly in the south-west: too-deep planting, wet situations and surface caking in silty soils were possible causes. **Root Plate Rot, Oedema** and **Sun Scorch** were noted, also damage due to hot-water treatment. **Grassiness** was seen in a wide range of cultivars: at Plant Pathology Laboratory, Harpenden, bulbs from grassy plants of many cultivars when separated out and grown on by the present author, invariably yielded normal plants.

Since 1955, a striking type of flower malformation has been seen following the pre-emergence use of the herbicide TCA (trichloroacetic acid and its salts). The effect was first observed by Mr. D. E. Horton at Rosewarne Experimental Horticulture Station in the 1955 crop, after TCA had been used in November 1953 to control weed grasses. The bulbs had behaved normally in 1954. Trials were carried out at Kirton E.H.S. and symptoms were seen on many commercial holdings often when bulbs had been taken in for forcing, The bulbs and leaves appeared quite healthy, but the flower buds were abnormally rounded rather than elongated and failed to open properly being trapped by the outer sheaths, which split at the sides with the continued pressure from the bud. The perianth segments themselves adhered to one another and when broken open revealed a strikingly convoluted and distorted corona. Up to flowering, general growth appeared to be quite normal. Complete losses of marketable blooms were experienced in some glasshouses.

It had been anticipated that the botanical relationship between bulbs and grasses might lead to injury with some chemicals. At Kirton, flower symptoms appeared 16 months after the date of application. The degree of damage apparently depended on such factors as dosage and efficiency of application. It might take several years for the bulbs to resume normal flowering behaviour if they were grown on in the field. Similar delayed

symptoms were seen following the previous use of the herbicide dalapon on growing sites (Turquand, *Expl Hort.* 1964, No. 11. 64-8).

Several instances of leaf tip damage in the Scillies and in Cornwall were reported in 1958 following zineb sprays in windy weather; and tip withering after spraying with copper oxychloride in cold windy weather occurred on one farm. In the latter case there was ten times more copper in the tissues of damaged leaves than in those of unsprayed ones. It was thought that the leaves were dessicated at the time of spraying allowing rapid absorption of the spray fluid.

NASTURTIUM Cabbage **Black Ring Spot** virus was noted in Merioneth. Tomato **Spotted Wilt** virus was known to infect nasturtiums.

NEMESIA At a nursery in Ches, large pallid necrotic areas were seen on the leaves of plants in boxes; infection was heavy. On incubation, abundant acervuli of a species of *Colletotrichum*, whose dark brown setae varied in length from 75-180 μm, were produced. W. R. Rosser reported that the spores were colourless, oval to pear-shaped, occasionally with a median septum and measured 18·8 μm x 4·5 μm (mean of 25 spores). **Damping-off** (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.) was found attacking nemesias in Middx in 1959.

NEPETA Several plantings failed on a holding in Oxon in 1959 and *Rhizoctonia* sp. was recovered from the rotted roots and crowns.

NERINE **Cucumber Mosaic** virus was confirmed in a sample showing distorted foliage in Norfolk in 1959.

OAK **Powdery Mildew** (*Microsphaera alphitoides* Griffon & Maubl.), mentioned occasionally in reports, is common and harmful on nursery stock. The incidence of perithecia has been recorded (Batko, *Pl. Path.* 1962, **11**, 184).

ORCHID (see also Cymbidium and Cypripedium) *Gloeosporium* is sometimes found on lesions on orchid leaves and may be *G. orchidearum* Karst. & Har. referred by Grove (*Br. Coelomycetes*, **2**, 263) to *Hypodermium orchidearum* (Cooke & Mass.). Not previously recorded here, *Cercospora odontoglossi* Prill. & Delacr., which causes a **Leaf Spot** abroad, was recorded in Dorset in 1961. **Cymbidium Mosaic** virus is commonly found in cymbidiums and other orchids. Necrotic spots on orchid leaves are often due to environmental conditions. Downie (*Nature, Lond.* 1957, **179**, 160) found that forms of *Corticium solani*, parasitic to other hosts, can act as endophytes of *Orchis purpurella*. Of interest was his find of a plant of this species bearing the collar-like fruiting structure of a *Corticium* on the stem at ground level, a phenomenon not previously recorded on orchids.

ORNITHOGALUM **Blue Mould** (*Penicillium* sp.) was reported in corms on a holding in Devon in 1957.

PAEONY **Blight** (*Botrytis paeoniae* Oudem.) was seen each year, and in 1961 was heavy generally in Holland (Lincs). Green and Brooks reported a great amount seen in 1959 (*Jl R. hort. Soc.* 1959, **84**, p. 529) which, as they pointed out was surprising in such a dry season. Wallace *et al.* have since reported on trials with fluid tecnazene and dispersible dicloran as soil drenches (*Pl. Path.* 1962, **11**, 33-5). The fungus has been noted on tree paeonies in Som and Sussex. Occasionally *B. cinerea* Fr. is recorded. **Blotch** (*Septoria paeoniae* Westend. var. *berolinensis* Allesch.) was noted

in reports in 1957 and 1961 and caused severe stem lesions, leaf crinkling and unilateral blackening of petioles and stems in two instances. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) affected a plot of plants in Kent. Paeony **Ring Spot** virus was reported from a few places in 1958, but was probably much more common than reports suggested.

PANSY see Viola.

PASSION FLOWER **Cucumber Mosaic** virus was confirmed in material from Surrey, and symptoms were seen in Yorks N.R. It was considered to be generally common in this host.

PELARGONIUM **Grey Mould** (*Botrytis cinerea* Fr.) affected some stocks, and die-back of cuttings was occasionally prevalent. **Foot Rot** (*Pythium* sp.) of cuttings was observed a few times and, in 1957, the odd case of foot rot of cuttings caused by *Phytophthora cryptogea* Pethybr. & Laff. and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. respectively. **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) probably occurs in slight amounts on many nurseries in this country and has sometimes been prevalent in individual stocks. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was recorded in *Geranium endressi* in Ches in 1959. A bacterium not previously recorded in this country, *Xanthomonas pelargonii* (Brown) Starr & Burkh.), the cause of **Leaf Spot,** was isolated from cvs. Paul Crampel and King of Denmark zonal pelargonium plants, received in autumn 1958 from a nursery in Ches. Knight *et al.* (*Pl. Path.* 1962, **11,** 29-30) recorded this attack and successfully reproduced the symptoms by inoculating the bacterium into healthy plants. They suggested that the abnormally wet summer of 1958 had largely influenced the occurrence of the disease, and no further trouble has been seen since on the nursery. A bacterial stem rot caused severe losses in some pelargonium stocks in Herts early in 1957, in some cases up to 50 per cent: it was very serious on a nursery in Essex in May that year.

Frequent reports of pelargonium **Leaf Curl** virus (Plate XI, 1) were received and some stocks were very widely infected. **Ring Spot** (pelargonium ring spot virus), apparently common, was also seen. Hollings (*Pl. Path.* 1957, **6,** 17-18) found this in ivy-leaved pelargoniums from widely separated areas and suggested that it was probably due to a virus. **Oedema** (non-parasitic) symptoms were noted once or twice.

PERIWINKLE The rather rare **Rust** (*Puccinia vincae* Berk.) appeared in a garden in Kent in 1960, and Brooks (*Jl R. hort. Soc.* 1966, **91,** p. 5) reported occurrences in 1961 at Guildford and Wisley.

PETUNIA There were records of **Foot Rot** (*Phytophthora cryptogea* Pethybr. & Laff.), and a few similar troubles were reported as due to *P. nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh., *Pythium* sp. and *Corticium solani* (Prill. & Delacr.) Bourd & Galz.. Plants in a garden in Herts, and in a bed at Rothamsted half a mile away, were found to be attacked by *Phytophthora infestans* Mont. de Bary in 1956 (Hirst and Moore, *Pl. Path.* 1957, **6,** 76). It is interesting to note that Berkeley recorded the fungus on petunias (*Gdnr's Chron.* 1856, **16,** 644) but no attacks had been seen since then in Britain.

PHLOX **Leaf Spot** (*Septoria drummondii* Ell. & Everh.) has not been uncommon and **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was seen in I.W. and Berks, while *Verticillium* sp. was noted causing wilt in Yorks

W.R. **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) appeared on two nurseries in Yorks W.R. and Kent respectively. **Cucumber Mosaic** virus is known to occur in phlox.

PINE A few attacks of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were investigated.

PITTOSPORUM **White Root Rot** (*Rosellinia necatrix* (Hartig) Prill.) was recorded in the Isles of Scilly. It has been seen there on this host before.

PLANE **Leaf Disease** (*Gloeosporium nervisequum* (Fuckel) Sacc.) was occasionally noted.

POINSETTIA **Grey Mould** (*Botrytis cinerea* Fr.) caused leaf loss in plants checked by a high pC on a nursery in Oxon. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was observed in Yorks W.R. and on a few occasions in Devon: *Pythium* sp. was also involved in one troublesome attack. In one of the Devon attacks, in which losses were serious, *Thielaviopsis* was isolated from sludge from the stream used as a source of water for the plants.

POLYANTHUS see Primula.

POPLAR **Canker and Die-back** (*Dothichiza populea* Sacc. & Briard) was reported from Northumb and Sussex. In the latter, in 1959, it was said to have caused the dying back of young shoots of a number of Lombardy poplars planted in 1954-5, death extending into two and three-year old wood. Severe defoliation of many trees of *Populus nigra italica* by **Leaf Spot** (*Marssonina populi* (Sacc.) Magn.) was seen at one place in Kent, *P. robusta* being less affected. **Rust** (*Melampsora larici-populina* Kleb.), **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer), **Yellow Leaf Blister** (*Taphrina populina* Fr.) and **Bacterial Canker** (*Aplanobacter populi* Ridé (see p. 294)) were all noted in reports. Rust affected half the leaves in a ¼-acre plot in Montgomery in 1959. The symptoms of the poplar **Mosaic** virus reported in Holland (Berg, *Nature, Lond.* 1963, **194**, 1302-3) have been seen in this country too.

POPPY **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr). was abundant and severe in oriental poppies in a garden in Salop in 1960. This appears to be a new host record.

POTENTILLA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer), not previously found on potentilla, attacked *P. fructicosa* in Sussex in 1961.

PRIMULA Several attacks of **Brown Core** (*Phytophthora primulae* Tomlinson) were reported every year on polyanthus, some of them very damaging. On a nursery in Ches in 1959, 2,000 out of 7,000 plants were attacked, but *P. juliana* cv. Wanda and *P. denticulata* were unaffected. **Leaf Spot** caused by *Ramularia primulae* Thüm. was seen quite often; but that caused by *Cercosporella primulae* Allesch. was noted only in Wilts, where it was prevalent on a polyanthus crop. Another leaf spot (*Phyllosticta primulicola* Desm.) was severe in frames, on American hybrid polyanthus plants raised from seed in Berks in 1959. The only other record on polyanthus in this country is that in Bristol in 1951, given by Robertson (*Pl. Path.* 1952, **1**, 102), but the fungus is very common on primroses. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was seen a number of times; and infrequently noted were **Foot Rot** (*Phytophthora* sp.), **Root Rot**

(*Pythium* sp.), **Grey Mould** (*Botrytis cinerea* Fr.), and a dying-off associated with *Rhizoctonia*. **Cucumber Mosaic** virus was confirmed on several *Primula* species and is probably quite common; it affects growth of the plants and the appearance of the flowers.

PRIVET **Die-back** (*Glomerella cingulata* (Stonem.) Spauld. & Schrenk) was reported in 1956 in a hedge in Berks by Roberts (*Pl. Path.* 1957, **6**, 76), and had previously been mentioned by Brooks (*Plant Diseases*, 2nd Edn, 1953, p. 230, Oxford University Press). The *Gloeosporium* stage (*G. fructigenum* Berk.) was present on cankers on several hedges suffering from die-back in Devon and Cornwall in 1957. Cuttings being propagated under 'mist' on a Berks nursery was severely rotted by *Rhizoctonia* sp. in 1958. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) is commonly recorded on privet and can be serious. **Arabis Mosaic** virus is considered to be very common, and **Cucumber Mosaic** virus is known in this host but seems not to be very damaging.

PRUNUS **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noticed on ornamental species of *Prunus*. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was noted in Kent, and **Bacterial Canker** (*Pseudomonas morsprunorum* Wormald) in several places, on ornamental cherry.

PYRACANTHA By 1960, **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) had spread to pyracantha. It was found attacking nearly 50 trees scattered throughout the Southend area, Essex by June that year. Blossom was mainly affected and, on this, infection was very heavy, up to 90 per cent in some instances. Very widespread blossom infection was seen later in 1960 but infection of the wood was uncommon. Pyracantha is known as a host of fireblight in the U.S.A. In 1960 **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted on this host for the first time.

PYRETHRUM Attacks of **Powdery Mildew** (*Erysiphe* sp.) were heavy generally in October 1959 on almost all crops grown for market in Holland (Lincs). It has been suggested that this mildew might possibly be *Erysiphe polyphaga* Hammarl. Other records were made in 1953 and 1956.

PYRUS **Powdery Mildew** (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) was confirmed in Cambs on an ornamental *Pyrus* sp. in 1959, and **Scab** (*Venturia pirina* Aderh.) was noted in Westmorland in 1961.

RANUNCULUS Records of **Powdery Mildew** (*Erysiphe polygoni* Mérat) came from Cambs (1957 and 1960) and Cornwall (1960). A **Root Rot,** seen in Oxon in 1960, was attributed to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., the plants also being severely attacked by *Botrytis*. A Claremont hybrid plant in a glasshouse at Rosewarne Experimental Horticulture Station, Cornwall was affected with **Calyx Smut** (*Urocystis anemones* (Pers.) Wint.) in 1959. The smut is known in this country on cultivated anemones and *Trollius*, and on wild *Ranunculus* species. A few plants were similarly affected in 1961 at Rosewarne E.H.S. **Turnip Mosaic** virus (anemone mosaic strain) was obtainable from some ornamental *Ranunculus* stocks.

RHODODENDRON **Leaf Scorch and Bud Blast** (*Pycnostysanus azaleae* (Peck) Mason) is frequently seen on rhododendrons and often damaging; some cultivars seem more susceptible than others. Some control, with 3 lb of zineb in 100 gal water with a wetting agent, was obtained in Wales, where it was said to have become increasingly prevalent.

In 1961, **Petal Blight** (*Ovulinia azaleae* Weiss) was found on rhododendrons at Richmond, Surrey (Reid, *Trans. Br. mycol. Soc.* 1969, **52**, 19-38). It had first been recorded in Scotland in 1950 (Paton, *Pl. Path.* 1954, **3**, 50) where it is now established, but it had not been seen in England. **Gall** (*Exobasidium vaccinii* (Fuckel) Woron.) (Plate IX, 3) was sometimes severe and often seen on imported azaleas and occasionally on imported glasshouse *Rhododendron* spp. In 1960, **Rust** (*Chrysomyxa rhododendri* de Bary) spread seriously at Trewithin, Cornwall in a rhododendron planting in which the disease had long been established but was not usually severe. Miss K. H. Johnstone, who had been observing these bushes for some years, reported that leaf yellowing usually starts in a characteristic marginal pattern on the dorsal side, uredo-and teleuto-spores appearing only on the ventral side. Defoliation may be severe enough to kill trees or to so weaken them that the grower discards them. Since 1954, Miss Johnstone had found the rust in 10 gardens in Devon and Cornwall and noted that in these cases it appeared to be confined to rhododendrons of the *cinnabarinum* series. She had seen it largely on *R. cinnabarinum* var. Roylei, to a lesser extent on *R. concatenans*, and on a number of hybrids all with *cinnabarinum* ancestry. Apart from a few other reports from Devon and Cornwall, rust was recorded only in Westmorland.

In June 1959, symptoms of **Leaf Spot** (*Cercospora handelii* Bubák) were noticed by Dale (*Pl. Path.* **9**, 76) on a nursery in Surrey where the disease was widespread on a number of rhododendron cultivars. Severe defoliation had been noted when the bushes were imported from Holland and Belgium two or three years previously. A *Cercospora* sp., probably this had been found by Mr. W. Buddin causing leaf spot in 1951 in Hants, and the disease is known in a number of countries in various parts of the world. Several cultivars were affected in Surrey in 1960, and it was slight on *Rhododendron ponticum*. In 1961 the fungus was found on a bush in Kent. Few attacks of **Leaf Scorch** (*Septoria azaleae* Vogl.) were reported. A batch of *Azalea indica* plants which had been imported from Holland in 1958 showed **Leaf Spot** (*Pestalotia macrotricha* Kleb.). A **Leaf Spot** attributed to *Botryosphaeria ribis* Gross. & Dugg was noted on a small number of rhododendron leaves at Southampton in 1957. **Leaf Spot** (*Gloeosporium rhododendri* Bri. & Cav.), previously reported from Devon and Cornwall, was found in rhododendrons in N. Wales in 1959. Dark rusty spots associated with a species of *Phyllosticta* were present on leaves, of some cultivars only, at a locality in the South-western Region. **Grey Mould** (*Botrytis* sp.) was another recorded trouble on azaleas. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was also noted on a few occasions on azaleas and rhododendrons. The weakly parasitic *Mycosphaerella rhododendri* Lindau was identified on rhododendron leaves examined during the period (Sutton and Pirozynski, *Trans. Br. mycol. Soc.* 1963, **46**, pp. 507-9).

Green and Brooks (*Jl R. hort. Soc.* 1959, p. 529) noted that the hot summer of 1959 lead to trouble associated with dryness of the roots, such as leaf scorching. A **Leaf and Twig Blight** (non-parasitic), presumed caused by a high CO_2 concentration during transport, resulted in much defoliation in imported azaleas on a Northants nursery early in 1959, similar trouble again being experienced at the end of the year.

ROMNEYA **Cucumber Mosaic** virus was isolated from two bushes of *Romneya coulteri*, obtained from different places (Hollings, *Rep. Glasshouse Crops Res. Inst. 1960*, 78).

ROSE The familiar **Black Spot** (*Diplocarpon rosae* Wolf) was particularly prominent in the wet summer of 1958. There were reports of widespread **Powdery Mildew** (*Sphaerotheca pannosa* (Wallr.) Lév var. *rosae* Wor.) from at least some areas in most years. **Die-back** (*Botrytis cinerea* Fr.) gave trouble on a few nurseries: *Botrytis* badly attacked hips in a breeding house in Flints. Both **Stem Canker** (*Leptosphaeria coniothyrium* (Fuckel) Sacc.) and **Canker and Die-back** (*Griphosphaeria corticola* (Fuckel) Höhnel) were mentioned in reports; also **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer). **Die-back** (*Gnomonia rubi* (Rehm) Wint.) had not been reported from any area for many years: this fungus was found to be associated with a canker on a nursery in Anglesey in 1961.

In 1957, **Downy Mildew** (*Peronospora sparsa* Berk.) was confirmed on several cultivars in a cool glasshouse in Leics, where leaf fall was severe and much of the crop was attacked. Considerable defoliation occurred in small areas on five nurseries in Herts and Essex the same year. On a nursery in Middx, where the mildew was seen in 1958 under glass, it was said to be affecting cv. Pearl of Aalsmeer particularly. Locally the disease had been known as 'Dutchman's Black Spot'. Other attacks were noted in Hants and Cornwall in 1961. Only a few severe attacks of **Rust** (*Phragmidium mucronatum* (Pers.) Schlecht.*) were brought to the attention of advisers: trials with various fungicides over several years have been reported in *The Research and Experimental Records of the Ministry of Agriculture, Northern Ireland.* **Leaf Spot** (*Sphaceloma rosarum* (Pass.) Jenkins) was reported only in 1959. It was present on a nursery in Som where it affected stems and twigs, and cvs. Flaming Sunset and Delightful seemed to be particularly susceptible. An outbreak on several plants being forced under glass in the Lee Valley in 1960 provided a new host record for **Violet Root Rot** (*Helicobasidium purpureum* Pat.). The myxomycete **Flowers of Tan** (*Fuligo septica*) was said to be smothering some plants in a nursery in Dorset in 1959. Infection of *Rosa rugosa* stocks by **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was reported a few times from Surrey. In one instance, half the stocks in an acre plantation was affected and, in another, cvs. Masquerade and Independence were attacked. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was severe at the graft union in two cultivars on a nursery in Beds and was seen in a few stocks elsewhere.

Virus symptoms are prevalent in certain cultivars and are usually noticeable as a blotchy mottle or a yellow vein-banding. Although more than one virus, including prunus necrotic ring spot, is involved the symptoms are at present commonly considered together under the name rose **Mosaic**. Some Floribundas are almost universally infected and symptoms show as a chlorotic mottling or vein-banding of the leaves varying in intensity from dark green to brilliant yellow. In 1961, Cropley (pers. comm.)

* In the past, rose rust has largely been attributed to *P. mucronatum*. In a recent survey, *P. tuberculatum* J. Müller was identified in all the rust-infected rose bush cultivars examined while *P. mucronatum* was found only on *R. canina* and var. *laxa* (Howden and Jacobs, *Natn. Rose Soc. Rose A. 1970*, 129-31).

isolated **Arabis Mosaic** virus from cvs. Masquerade and Faust received from the east Midlands, the first example of a soil-borne virus detected in rose. Unusual leaf symptoms were found in August 1961 on some glasshouse rose bushes at the Lee Valley Advisory Unit of the N.A.A.S. The cultivar was New Yorker grafted onto *Rosa canina*. Fletcher and Kingham (*Pl. Path.* 1962, **11**, 92) attributed the symptoms to **Rose Line Pattern** virus, considered to be a form of rose mosaic (see above), and this was the first recorded occurrence in this country.

A collapse of flowers with blackening of the flower stalks, of unknown cause, was seen in one or two instances in the south-west. **Oedema** (non-parasitic) was noted once or twice in the Eastern Region, in one case under badly ventilated glass. A failure of standard rose buds to break was widespread in Leics in 1957 and appeared to be connected with the late spring frosts: the mild 1956/7 winter encouraged premature development of buds and at the time of examination much of the graft tissue was brown and discoloured. The scions in budded standard roses were killed by **Frost Injury** in May 1957 in a planting in Leics.

ROWAN **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were occasionally reported. A die-back of a tree in a Salop garden in 1960 was attributable to infection of the spurs by a species of *Gloeosporium*. Several street trees in Surrey had dead branches and well-defined cankers bearing fructifications of **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) in 1960. **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) was found on *Sorbus aucuparia* in Surrey (Billing *et al.*, *Pl., Path.* 1959, **8**, 152).

RUBBER-PLANT A disease agreeing with **Anthracnose** (*Colletotrichum ficus* Koorders syn. *Gloeosporium elasticae* Sacc.) was present on severely damaged leaves of a *Ficus elastica* plant in Merioneth in 1959, and a species of *Gloeosporium* was associated with necrotic areas on the leaf of a plant in Salop in 1958. Grove (*Br. Coelomycetes*, **2**, p, 231) quotes a record on dead leaves, in Scotland. Some species of *Gloeosporium* are regarded as parasitic on this host in certain countries. The plant in Merioneth was subjected to wetting of the leaves and chilling, conditions said to encourage this apparently common trouble in the U.S.A. On a nursery in the Lee Valley the under surfaces of leaves of *F. decora* sprayed with white oil were severely blistered by **Oedema.**

RUDBECKIA Symptoms suggestive of **Cucumber Mosaic** virus were seen on a nursery in N. Wales in 1961.

SAINTPAULIA **Grey Mould** (*Botrytis cinerea* Fr.) was severe on a nursery in Carms in 1961 and **Powdery Mildew** (*Oidium* sp.) was seen in Suffolk in 1960, attacking flowers as well as leaves, and in War, Sussex and Herts in 1961. These were the first fungi to be recorded on saintpaulias since the plant became popular in this country. The physiological ring pattern attributed by Hollings (*Pl. Path.* 1955, **4**, 123-8) to chilling of the leaves in sunlight, has been reported in some plants.

SALPIGLOSSIS A species of *Pythium* caused damping-off in Norfolk.

SALVIA *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. caused **Root Rot** and related troubles in one or two crops in Lancs and the south-east: in one attack in Kent, 80 per cent of several hundred plants had foot rot. *Pythium* sp. and *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur)

Waterh. caused **Damping-off** in nurseries in Bucks and Middx respectively.

SANSEVIERIA A **Leaf Spot** associated with a species of *Heterosporium* affected nearly half of a batch of plants in N. Wales in 1959 but the main trouble was probably an effect of cold temperatures.

SAXIFRAGE *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. were isolated from the rotted roots and crowns of several species of saxifrage on a nursery in Oxon in 1958. These fungi have not been noted before on this host in Britain.

SCABIOUS **Leaf Spot** (*Ascochyta scabiosae* Rabenh.) (Plate XVI, I) only once noticed in Britain previously (1950), was recorded in Ches in 1957. There was a report of **Powdery Mildew** (*Erysiphe polygoni* Mérat) from Surrey, and **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was very severe on two nurseries in Hants and Som respectively, causing considerable losses in one. **Root Rot** (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.), not previously noted on scabious, was confirmed on a nursery in Surrey, where about 20 per cent of ¼-acre of the plants of cv. Clive Greaves, from 1-3 years old, mostly irrigated, were dying in 1959.

SCHIZANTHUS There was a record of **Powdery Mildew** (*Oidium* sp.) from Yorks W.R. (1960); and one of **Foot Rot** (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.), not seen before, from Surrey (1959).

SCHIZOSTYLIS Specimens with leaf and stem spotting associated with *Botrytis* sp. were received from Cornwall in 1958. A leaf and flower spotting sometimes associated with *Botrytis* but not always, was encountered in most years in the Starcross Sub-Region. A further record of **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst.), a disease seen in Devon in 1949, came from the same county in 1961.

SEMPERVIVUM Large numbers of plants of *Sempervivum tectorum* were infected by **Rust** (*Endophyllum sempervivi* de Bary), which was apparently stunting growth.

SHRIMP PLANT Galled buds due to **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) were present on a few young *Beloperone guttata* plants on a nursery in Berks in 1960.

SINNINGIA (Gloxinia) **Grey Mould** (*Botrytis cinerea* Fr.) appeared on plants in a Yorks N.R. glasshouse. *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. caused a **Stem and Tuber Rot** on several nurseries, with extensive losses on one in Middx where plants were growing in very acid compost. In one attack of foot rot, *P. cryptogea* Pethybr. & Laff. was also involved. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted once, killing many potted plants. The **Corm Rot** described by Moore and Tomlinson (*Pl. Path.* 1953, **2**, 71), and thought to be of physiological origin, is sometimes seen in imported consignments. Tomato **Spotted Wilt** virus was known to occur in this host.

SNOWBERRY **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found on *Symphoricarpus racemosus* in 1957.

SNOWDROP **Grey Mould** (*Botrytis galanthina* (Berk. & Br.) Sacc.) was noted in Yorks N.R., but otherwise was not a subject of enquiry.

SOLANUM CAPSICASTRUM (Winter Cherry) *Botrytis* sp. severely attacked a batch of plants in Yorks. **Oedema** (non-parasitic), to which this host seems susceptible, was noted in another lot; and in Glos in 1958, cell proliferation and 'woolliness' of stems, accompanied by die-back of shoots and leaf-fall were first noticed about a week after bringing the plants into a glasshouse and were said to have developed rapidly among many plants. This is an effect similar to that found in Bristol in 1937 and described by Moore in *Bull. Minist. Agric. Fish.* No. 126, 1944, p. 89.

SPRUCE On a nursery in Som, the leaves of a large patch of Norway spruce seedlings were yellowing. The perfect stage of **Violet Root Rot** (*Helicobasidium purpureum* Pat.), identified by the Forestry Research Station, was present on the bases of the stems. The fungus has previously been recorded on Sitka spruce in Scotland. Growth of a species of *Thelephora* was extensive around the bases of several thousand young trees about 18 in. high in a nursery bed in Wilts in 1961. There was some associated leaf browning on the lowest branches.

STATICE *Alternaria alternata* (Fr.) Keissler (syn. *A. tenuis*) attacked seedlings in boxes on a nursery in N. Wales in 1961: this was believed to be the first record of the fungus on this host in this country. Rotting of pedicels and flowers due to *Botrytis cinerea* Fr. was serious in a crop in Berks. **Powdery Mildew** (*Erysiphe polygoni* Mérat) was general and severe in a small planting of *Statice sinuata* in Worcs in 1961; and severe attacks were seen in two crops in Herts and Berks respectively. A small plot of *S. latifolia* in Worcs had about 20 per cent of **Rust** (*Uromyces limonii* (DC.) Lév.); it was severe on some plants and affected the flowering stems. A species of *Phoma* was associated with leaf and stem lesions on plants of *S. latifolia* in Cambs in 1958, flowering stems being badly disfigured.

STOCK Outbreaks of **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) were fairly frequent; several crops were completely affected. In Sussex, 30 boxes of seedlings were entirely infected when placed outdoors for hardening off, but there had been no sign of mildew under glass. In 1960, infection was light to very heavy, and general, in Middx. In Cambs, where there were several severe attacks in 1961, some control was obtained with zineb dust. **Leaf Spot** (*Alternaria raphani* Groves & Skolko) is an uncommon disease of stocks. In the South-eastern Region in 1959, several seed samples were tested in a germinator and *A. raphani* was found in five of these. When the same seeds were sown in JI compost, they grew perfectly whether treated with captan or left untreated. From cultures of the fungus obtained from the seed, a spore suspension was prepared which, when sprayed onto the young seedlings, caused severe leaf spotting and killed a high proportion of the seedlings. The only other record of this leaf spot came from Som in 1961. **Grey Mould** (*Botrytis cinerea* Fr.) appeared a few times; and **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was often troublesome, also the related wire stem and root rot conditions, and some losses were heavy. **Foot Rot** (*Phytophthora* spp.) was infrequent, while **Root Rot** (*Pythium* sp.) caused partial failure of a batch of young seedlings in Worcs in 1960.

The **Cabbage Black Ring Spot** strain of turnip mosaic virus was reported to be severe at several places in E. Suffolk in October 1959, and

was noted in a few plantings elsewhere. Both **Cucumber Mosaic** and **Cauliflower Mosaic** viruses were confirmed (by the Virus Research Unit, Cambridge) in plants received from Norfolk in 1960 with a leaf mottle. The **Anemone Mosaic** (strain of turnip mosaic) virus, causing flower breaking and quite common on *Matthiola*, was confirmed in Devon.

STRANVAESIA **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) was recorded on *Stranvaesia davidiana* in 1960.

SWEET PEA **White Mould** (*Ramularia deusta* (Fuckel) Karakulin f. *odorati* Baker, Snyder & Davis) was reported from Hunts and some southern counties, but **Powdery Mildew** (*Erysiphe polygoni* Mérat) attracted almost no attention, except that it was above average in N. Wales in 1957 and at Bangor differences in the susceptibility of the cultivars became apparent. Cultivar Robert appeared to be very susceptible to mildew, and fairly susceptible were cvs. Patricia Unwin, Daisy, Gigantic, Welcome and Connie. Piccadilly, Airwarden, Flame, Mrs. C. Kay, Carlotta and Cream Delight remained fairly resistant, while Joy and Waneta appeared to be resistant. Root troubles were caused in a few places by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., *Pythium* sp., *Fusarium* sp. and *Aphanomyces euteiches* Drechsl., while **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was not infrequent, particularly in the north. An attack of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was investigated in Sussex in 1958; and **Verticillium Wilt** (*Verticillium dahliae* Kleb.) in Sussex in 1959, *Verticillium* sp. being recorded in 1958 in Glos. Stem lesions due to **Grey Mould** (*Botrytis cinerea* Fr.) occurred in a crop in Sussex in 1961, and a species of *Ascochyta* was associated with a die-back in Wilts in 1957.

Leafy Gall (*Corynebacterium fascians* (Tilford) Dowson) was noted and can be severe. On a Devon nursery, infection was up to 50 per cent in some cultivars growing in pots prior to planting out in a glasshouse. The seeds had been sown individually in pots containing sterilized soil which may suggest that the seed was infected. Jacobs and Dadd (*Ann. appl. Biol.* 1959, **47**, 666-72) examined the role of antibacterial substances, which they detected in seed coats, in the infection of sweet peas by the leafy gall organism. Lacey (ibid. 1961, **49**, 634-44) reported on the development of filter-passing organisms in cultures of *C. fascians* derived from sweet peas.

A number of virus diseases, usually termed **Streak** and **Mosaic,** are not uncommon. **Pea Mosaic, Pea Enation Mosaic** and **Bean Yellow Mosaic** have all been recorded on several occasions.

SWEET WILLIAM The most important disease of sweet williams is **Rust** *Puccinia arenariae* (Schum.) Wint.) which was frequently severe and found in many parts of the country. **Leaf Spot** (*Mycosphaerella dianthi* (Burt) Jørstad) was noted only occasionally, in 1957 and 1961; and **Leaf Spot** (*Ascochyta dianthi* Berk.) was only severe in one crop in Devon and rarely mentioned otherwise. **Leaf Spot** (*Alternaria dianthi* Stev. & Hall) was confirmed on leaves of sweet williams in a garden near Wolverhampton in 1960: though known as a cause of stem rot of carnation and recorded on *Saponaria*, the fungus had not previously been seen on sweet williams in Britain. Fifteen per cent of a batch of 12,000 plants were dying in patches in Surrey in 1959 due to **Stem Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.); and **Violet Root Rot** (*Helicobasidium purpureum* Pat.)

was recorded near Peterborough in 1958: neither disease had been previously noted. *Volutella dianthi* (Halst.) Atk. was associated with a **Stem Rot** of a batch of sweet williams in the South-western Region in 1960. Carnation **Vein-Mottle** virus was known to be very common in gardens.

SYCAMORE The ubiquitous **Tar Spot** (*Rhytisma acerinum* Fr.) appeared in reports, as did **Powdery Mildew** (*Uncinula bicornis* (Fr.) Lév). **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was recorded in Worcs in 1958; and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was also reported on sycamore. After a decline for some years, **Sooty Bark** (*Cryptostroma corticale* (Ell. & Everh.) Gregory & Waller) had apparently resurged by 1960 and 1961 in the London area and had been found further afield (Pawsey, *Pl. Path.* 1962, **11**, 138).

TEASEL **Powdery Mildew** (*Oidium* sp.) was reported to be prevalent on Fullers' teasel (*Dipsacus fullonum*) at Cheltenham, Glos in October 1959. This was the first time a powdery mildew had been seen on this host in this country. **Leaf Spot** (*Phoma* sp.) was newly recorded in the South-western Region (Som) in August 1958. **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) was also seen in Som in 1958, associated with a species of *Pythium* in rotting of the bases of plants probably following splitting of the stem bases.

THUJA A few outbreaks of **Leaf Blight** (*Didymascella thujina* (Durand) Maire) were notified.

TOBACCO A connection between the first appearance of **Blue Mould** (*Peronospora tabacina* Adam.) in England and investigations on the disease being conducted in the country at that time must be strongly suspected.

In October 1958, the fungus appeared simultaneously on *Nicotiana* spp. in glasshouses at three places in the south-east. Plants of *N. glutinosa* and *N. tabacum* for virus testing were infected at the Glasshouse Crops Research Institute, Sussex, and the mildew was discovered at the N.A.A.S. sub-centre at Wye, Kent. Further, considerable losses were caused on a commercial nursery in W. Sussex, where it was confined to seedlings.

Later, test plants at Rothamsted were found to be affected.

The mildew did not reappear, after the autumn and winter of 1958-9, until autumn 1960. Both 1958 and 1960 were wet years with poor summers, while 1959 was largely hot and dry.

Some of the outbreaks in 1960 were outdoors. Infection was found in the new glasshouse of the Plant Pathology Laboratory, Harpenden on 12 September, and at Rothamsted four days later. Mid-September brought a report from a commercial nursery in Sussex where *Nicotiana*, grown for virus diagnosis, was affected. In October, two further research centres (Cambridge and Hertford) experienced the disease; and the same month seven outbreaks were recorded on plants grown out-doors for smoking-tobacco in Essex, Sussex and Kent. A virus testing unit was affected in November in Worcs.

Blue mould was not seen again until July 1961, but from then until mid-November, 14 outbreaks, all in the southern half of the country, were recorded. Five were under glass for virus testing, eight on plots of tobacco grown for curing and one on ornamental *Nicotiana* spp. grown outdoors for experimental purposes. At Bristol, the disease was found on *N. sanderae* *N. silvestris*, *N. affinis*, *N. glauca* and *N. rustica* but not on *N. suaveolens*.

The disease appeared at several places in Devon the following year, and at Rothamsted and in Berkshire, but has not been seen since.

Blue mould was unknown in Europe before 1958 but the initial outbreaks in England and its occurrence in 1958 at Wageningen, Holland (Zadoks, *Neth. J. Pl. Path.* 1967, **73**, Suppl. 1, 61-80) were followed in later years by disastrous spread throughout Europe and beyond.

TRADESCANTIA **Damping-off** (*Rhizoctonia* sp.) caused considerable losses of *Tradescantia tricolor* on a holding in Surrey in 1958. **Grey Mould** (*Botrytis cinerea* Fr.) was noted.

TRITONIA **Iris Mosaic** virus was known to be not uncommon..

TROLLIUS see Globe Flower.

TULIP The epidemics of **Fire** (*Botrytis tulipae* Lind) were not outstanding in any one year, though they were serious early in 1958 in several areas. In 1960, fire was reported on *Tulipa eichleri* in Yorks. Fire is difficult to control: success with fungicides has been variable and from work done by the N.A.A.S. at Kirton Experimental Horticulture Station, it appeared that control with the current fungicides must also involve care in handling bulbs and the sorting out of infected ones before planting. The experiments at Kirton up to 1960 are discussed in the station's *Review of Bulb Experiments*, 1960, 30-3 (N.A.A.S.). Fungicidal spraying in the field, the use of bulb dips and sprays, soil treatments and manual treatment of bulbs were being studied by the N.A.A.S. at Rosewarne E.H.S., Cornwall. Green and Brooks (*Jl R. hort. Soc.* 1958, **83**, 517-8) substantially reduced infection from contaminated soil with quintozene, and Rhodes *et al.* (*Ann. appl. Biol.* 1957, **45**, pp. 217-21) found that griseofulvin compared favourably with ferbam in small-plot control trials.

Previously not recorded in England and Wales, **Fusarium Bulb Rot** (*Fusarium oxysporum* Fr. f. *tulipae* Apt) was seen in the Eastern Region in 1960 and 1961. A trial in the Region established the pathogenicity of the fungus. Although it was known in Holland, Germany and Canada at least, there seemed to be little literature on the disease. Several attacks were investigated in 1960. In Essex, 70 per cent of 25,000 bulbs of cv. White Sail, imported from Holland, were dying in February, though another batch of this cultivar from another Dutch firm behaved normally. The bulbs were boxed in late September and brought in at the beginning of January. Large basal lesions usually spread up on one side of the bulb, with a suggestion of shanking in the centre. Symptoms were similar in cv. Fridolf Nansen on a nursery in Beds: the soil in the boxes had been used for gladioli which had later developed fusarium rot after storage. A *Fusarium* of the *F. oxysporum* type, visible also on the scales, was isolated onto potato dextrose agar from bulbs from both attacks. Infection was seen in Holland (Lincs) in cv. Pink Perfection, and may have been present in the winter of 1959/60 in Holland (Lincs). The same basal rot was found on cv. White Sail being forced in Derby in 1960 from imported bulbs, and a stock of forced tulips, cv. Her Grace, showed a high proportion of flower failure with basal rot and some root rotting. Fusarium rot was moderate in 1961 on imported bulbs in Holland (Lincs) and was noted in Norfolk in Rose Marie, a cultivar said to have been similarly affected for several years. Poor growth, with root and stem rot, was associated with a species of *Fusarium* in a crop in Dorset in 1960.

Bulb Rot associated with species of *Penicillium* has been mentioned in reports. Often *Penicillium* colonizes only superficial, damaged, tissues of tulips, but sharply defined pale brown lesions were present on the outer scales of some forced bulbs received in 1958 from the south-east and the north. Invariably only *Penicillium* developed on incubated bulbs and it seems that the fungus could have been behaving pathogenically. In 1959, *Penicillium* spp. were widespread on local bulbs in Holland (Lincs). A number of attacks of **Shanking** (*Phytophthora cryptogea* Pethybr. & Laff. and *P. erythroseptica* Pethybr.) in forced tulips were brought to the attention of advisers each year, many of them involving very high percentages of infected plants. On a holding in Mon in 1958, outdoor crops of cvs. William Pitt and William Copland were said to have shanking. In Som, only 10 per cent of 5,000 bulbs of cv. White Sail in boxes, produced normal plants; the remainder were infected with **Pythium Rot** (*Pythium* sp.). The bulbs had been imported from Holland. Lesions on stems and leaves, apparently caused by *Rhizoctonia*, were noted in certain boxes of forced cvs. William Pitt, Red Pitt and Snowden on a nursery in Devon in 1958. **Grey Bulb Rot** (*Sclerotium tuliparum* Kleb.) was locally severe in parts of the Eastern Region in most years, but elsewhere apparently not much in evidence. It was recorded for the first time in Lancs in 1959.

Tobacco Necrosis virus was first reported by Kassanis (*Pl. Path.* 1954, **3**, 26-9). Since 1949 he had confirmed infection in 16 outbreaks in the eastern and south-eastern counties, cv. Korneforos being most often involved. At that time incidence tended to be low in field tulips. Numbers of attacks have been confirmed during the 1957-61 period. 1959 was the worst year for several years in Holland (Lincs) : the disease was slight everywhere with bad patches locally. It was more common than usual in forced tulips in parts of the Eastern Region in the late winter of 1961/2. Tulip **Breaking** virus is frequent in stocks. Bond (*Pl. Path.* 1961, **10**, 147-9) studied its development from 1950-8 in a stock of cv. Pride of Haarlem, Darwin tulips.

A distortion of the shoots of Copland cultivars similar to that described by Moore in 'Diseases of Bulbs' (*Bull. Minist. Agric. Fish.* No. 117, 1939, p. 42 and Fig. 16.) was noted in 1958 on three nurseries. On one in Cambs, Dutch and English stocks of cv. Red Copland were badly affected, with shoots folded over within the bulbs, and the foliage crooked and crumpled on emergence, while some shoots failed to emerge. Failure to flower was common in cvs. Rose Copland and Pink Glow on two nurseries in the west Midlands in 1960 and was attributed to high temperatures at lifting in the previous season. Abnormally short stems due to heating of the bulbs were recorded in several crops in the east Midlands in 1960.

Preparation Injury occurred with several stocks. **Blindness** was more prevalent than usual in the East Midland Region in 1959 and, in 1961 was common in cvs. Her Grace and White Sail in most nurseries in W. Wales. **Topple** was observed in a number of crops: in one case affecting 40,000 bulbs. Other non-parasitic troubles infrequently noted were **Hard Base** and **Fasciation.** In Kesteven (Lincs) there was a fair amount of **Frost Injury** in 1958, which was especially seen in the small deeper planted bulbs.

During 1957 and 1958 in particular, a series of unusual symptoms were reported on forced tulips from the East Midland, Eastern and

South-eastern Regions. A lot of trouble was experienced in the east in 1957, some crops being affected to the extent of 50 per cent or more. The cause or causes of these symptoms had not been determined. The symptoms most frequently found, and brought to the attention of Plant Pathology Laboratory, Harpenden by E.R. Wallace were:

1. A dry brown discoloration of the scales close to the flower stalk, particularly on the inner side, seen when bulbs are cut open. Sometimes though not always, this discoloration extends down from the neck region, and may continue for a considerable distance into the internal tissues. Attempts to isolate an organism from these areas failed.

2. Yellow or yellow-brown ladder-like markings found on the inner scales reminiscent of damage caused by bulb scale mite in narcissus. In spite of many examinations no mites were found associated with these symptoms in tulips.

3. Tattering, splitting and tearing of the leaves, of varying degrees of severity, sometimes very severe. The symptoms appeared to be distinct from the shredding often attributed to frost damage and which was common in 1957.

These symptoms could sometimes be found together in a single bulb but it was not established if there was any connection between them. The internal discoloration (1) was thought to be unconnected with the tattering and the ladder markings. Symptoms of categories (2) and (3) were not uncommon and traces have been noted in tulips for many years; they were often associated but may have no common cause.

The symptoms of leaf tattering etc. in 3, along with other symptoms noted at this time, lead one to suspect that a bacterial disease, caused by *Corynebacterium oortii* Saaltink & Maas Geesteramus and now known to be established in tulip stocks in this country, may possibly have been involved in at least some of the outbreaks but no checks for bacteria were made at the time. The field symptoms of this disease are known to Dutch growers as 'hell-fire'.

VERBENA **Broomrape** (*Orobanche* sp.) was found in a Wilts garden on *Verbena bonariensis* in 1958.

VERONICA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted.

VIBURNUM **Die-back** (*Botrytis cinerea* Fr.) was seen in one or two species and, in 1959, a specimen with **Leaf Spot** (*Ascochyta viburni* (Roum.) Sacc.) was received from Devon. *Verticillium dahliae* Kleb. was isolated from discoloured wood of dying shrubs, which also showed severe botrytis die-back, in the south-east in 1960.

VIOLA **Damping-off** and **Stem and Root Rot** due to *Pythium violae* Chesters & Hickman, **Leaf Spot** (*Ramularia agrestis* Sacc.) and **White Spot** (*Ramularia lactea* (Desm.) Sacc.) were each recorded a number of times. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.), **Stem Rot** (*Myrothecium roridum* Fr.), **Foot and Root Rot** (*Phytophthora* sp.) and **Stem Rot** (*Botrytis* sp.) were also noted. A species of *Ascochyta* was associated with a stem rot of pansies in Lancs in 1960. Several attacks of **Leaf Spot** (*Phyllosticta violae* Desm.) occurred on violets in Devon and Cornwall in 1957. **Smut** (*Urocystis violae* (Sow.) Fisch. v. Waldh.) apparently gave very little trouble. *Rhizoctonia* was noted causing root or

foot rots; in one case, of extensive infection, *Phoma* sp. was also said to be attacking plants. **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) was fairly severe in an attack on violets in Cornwall. Rotting of the growing points and petioles and spotting of the leaves was present in violet specimens from two places in Cornwall, and one in Devon, in 1960. There were high bacterial populations in the lesions and the trouble was probably linked with very wet conditions. **Cucumber Mosaic** virus was not uncommon on violas, reducing flower quality and vigour.

WALLFLOWER **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) was seen each year and caused some almost complete failures in the south-west in 1958. Symptoms were puzzling at first in an $\frac{1}{8}$th acre block of plants which failed in the Isles of Scilly. Though the mildew was sporing on a very few plants, examination of those which had shed most of their leaves, however, showed that there had been systemic invasion of the cortex. Proliferation of lateral buds was common. **Leaf Spot** (*Alternaria cheiranthi* (Lib) Bolle) of doubtful parasitism, was noticeable in the garden at Bristol University in February 1960, and looked as though it could become serious, but by flowering time in April and May, it was difficult to find signs of infection. A very severe attack was reported on cv. Crimson Bedder on a Lee Valley nursery in 1961. Shoot death in a crop in Som was associated with this fungus and **Grey Mould** (*Botrytis cinerea* Fr.) together. **Club Root** (*Plasmodiophora brassicae* Woron.) was reported in half a dozen crops. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) caused **Damping-off, Root Rot** or **Wire Stem** in a few instances and, with a species of *Phytophthora*, was involved in a very extensive outbreak of root rot in a park in Glos. Also noted were **Leaf Spot** (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) and **White Blister** (*Albugo candida* (Hook) O. Kuntze). Alpine wallflower plants were attacked by **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) on a nursery in Northumb in 1960. **Flower Breaking** (cabbage black ring spot strain of turnip mosaic virus) was very common in Yorks W.R. in 1960, and Dr. T. E. T. Bond (pers. comm.) reported it to be unusually prevalent in Bristol University laboratory gardens that year. According to Dr. Bond it was recognizable in flowers of all colours associated with anthocyanin pigment i.e. in orange, brown, purple and 'art' shades, as well as in the familiar blood-red. A count of these colours only, in some beds of large well-grown plants of mixed cultivars gave 483/681 plants affected (71 per cent), whereas a similar count among closely crowded, mostly single stemmed plants in part of the original seed bed left unthinned, gave only 281/744 (38 per cent). This apparent 'size of plant' effect suggested that some at least of the infection had occurred after transplanting.

WEIGELA Both *Pythium* sp. and *Rhizoctonia* sp. were associated with a rot of cuttings on a holding in Caerns in 1959.

WHITE BEAM **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) was first confirmed in trees of white beam (*Sorbus aria*) lining streets in Southend, Essex in 1959 (Billing *et al.*, *Pl. Path.* 1959, **8**, 152) and about 60 trees had to be disposed of. This was thought to be a new host record, although some other *Sorbus* spp. including rowan (*S. aucuparia*) were known hosts in other countries (for the first English record on rowan, see p. 195). A further 63 infected trees were found later that year in gardens, parks or road sides

in an area between the eastern end of Canvey and Shoeburyness. Infection was extensive in the Southend area in May 1960 though little was found there on pears. During 1960, the disease spread considerably in white beam in London and its adjoining suburbs and particularly in Southend. There were reports from Kent too. Some forms of white beam, probably related to *S. intermedia*, appeared to be resistant. In contrast to the position in 1959 most of the infection in 1960 took place through blossoms.

WILLOW **Black Canker** (*Physalospora miyabeana* Fukushi) was reported several times. Pustules of **Scab** (*Venturia chlorospora* (Ces.) Karst.) were noted on leaves in an outbreak in Salop, cankers of *Physalospora* having been seen the previous autumn. *Physalospora* killed many branches in a windbreak of *Salix vitellina* in Pemb in 1959. Scab was noted in Sussex. The relative importance of *Venturia* and *Physalospora* remains uncertain: the situation was summed up by Peace (*Pathology of Trees and Shrubs*, pp. 463-4 and 466).

In 1961, **Anthracnose** (*Marssonina salicicola* (Bres.) Magn.) was thought to have been more than usually common in weeping willows in Wilts. It was noted in Devon in 1959. There was a record of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) on weeping willow. Uredia of **Rust** (*Melampsora amygdalinae* Kleb.) were commonly seen in small amounts on leaves in all ages of beds in two areas of Som surveyed in 1959, but there were virtually no stem infections.

WISTARIA Until these years, wistaria had not been noticed as a host of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer), but there were single records in 1958, 1959, and 1960.

YUCCA **Leaf Spot** (*Coniothyrium concentricum* (Desm.) Sacc.) was noted in southern counties.

ZINNIA **Leaf Spot and Seedling Blight** (*Alternaria zinniae* Pape) occasionally caused very severe losses. Beaumont *et al.* (*Pl. Path.* 1958, 7, 52-3) found it commonly in seed stocks tested in 1956, and investigated seed treatment with thiram, mercuric chloride, and hot water. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) attacked two Sussex crops in 1960; in one, 15 per cent of the plants in a large glasshouse was affected. Also recorded infrequently were **Stem Rot** (*Botrytis cinerea* Fr.), and **Damping-off** due to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. and *Pythium* sp.

PART II

DISEASES OF CULTIVATED PLANTS
1962-1968

N.B.—Many diseases of lesser importance which were reported in Part I have been omitted from Part II if their status has not altered.

Weather Conditions

More-detailed reports on the weather during 1962-68, *contributed by the Agricultural Branch of the Meteorological Office were published in 'Plant Pathology' (No.* 3 *of Vol.* 11 *and Nos.* 1 *and* 3 *of Vols.* 12 *to* 18 *inclusive). The following are the main features:*

1962 The early months were mild, February being dry, but the spring was persistently cold and crops were much delayed. Frosts in late May and early June were damaging. The summer was cool, and until August and September the weather was relatively dry. Autumn was warm at first, stormy at times and the year ended with cold and snow.

1963 An exceptionally cold winter. Snow at the end of 1962 often persisted for up to two months. Up to May the spring was mild and wet. The summer mostly lacked sunshine, and rainfall was average or above. A mild autumn and a wet November led to a cold and very dry December.

1964 An outstandingly dry winter, but March was wet and cold. A changeable period followed, but the latter part of summer was dry and soil moisture deficits were often large. This notable lack of rain continued into autumn and winter.

1965 The early months were rather cold. Most areas still had high soil moisture deficits when winter ended. Spring and summer were mainly cool, changeable and wet. October was notably dry, and soil moisture deficits returned in autumn and early winter and lasted until the wet December.

1966 A variable start was succeeded by dull and wet weather. March was dry, and April dull, cool and wet. Conditions became changeable and a wet summer followed nearly everywhere, though July was relatively drier in the north-west. The autumn was mild, dry at first but wet later, and December was also mild.

1967 The winter was mostly mild and sunny, and spring early with few air frosts. However, April and May were cool, and the latter very wet. Summer was mainly dry but October was the wettest on record though sunshine was near average. The rest of the year was dry, and cold at times in many areas.

1968 A cold start led to milder weather, but February was very cold with many night frosts: in these early months rainfall was not exceptional. Spring temperatures and rainfall were variable with the early part of April cold with some severe night frosts. The summer and early autumn tended to be wet and often dull, and the remaining months were rather dry in much of the country; October was unusually mild but much of December cold.

Diseases of Cereals

Among the major problems facing advisers was the need for information on the hazards connected with intensive cropping of wheat and barley, in particular the build up of the root diseases. Also greater knowledge of the effect of the leaf diseases, particularly mildew, aroused interest in their control by fungicidal sprays.

Wheat

From 1962 to 1965, and again in 1968, **Yellow Rust** (*Puccinia striiformis* Westend.) was of little consequence, though it was noticeable in 1964 in some areas. Its scarcity was associated with the widespread use of, both winter and spring, resistant wheats.

The 1966 season was very different. The rust became prevalent in winter and spring wheats and some barley crops in most of the country to the north of the Midlands and the extreme south-west, but developed most dramatically on winter wheat cv. Rothwell Perdix which till then had been regarded as resistant. The consequence to this cultivar recalled the decline, because of susceptibility to this rust of earlier, otherwise promising, cultivars; such as Heines VII a decade earlier. In some Regions all or most crops of Rothwell Perdix were infected: in others, although the rust was widespread it seemed less damaging. Macer and Doling have discussed the identification and possible origins of the race ('60') affecting Rothwell Perdix (*Nature, Lond.* 1966, **212,** 643). Other cultivars severely affected in 1966 were Hybrid 46, Opal and Kloka.

During 1966 and 1967 the once prevalent races 2B and 8B quickly declined, to be superceded by races 60 and 3/55. Rust extensively affected several cultivars in 1967, though, in general, it was less prominent than in 1966: race 60 attacked Rothwell Senator as well as Rothwell Perdix, race 3/55 the spring wheat Opal and winter wheats Cappelle Desprez and Champlein, and both races attacked the spring cultivar Kloka (Macer *et al.*, *Rep. Pl. Breed. Inst. 1965-66*, 117-8; Johnson and Wolfe, ibid. *1966-7*, 109-10). In 1967, widespread and severe attacks occurred to the north of the Midlands too and in Wales: in S. Wales 25-50 per cent infection levels were reached in Rothwell Perdix by the end of May, and by June many crops had to be made into silage.

The reduction in the acreage of the cultivars susceptible to race 60 no doubt contributed to the lower level of rust in 1968.

In seven of the 12 years 1956-67, yellow rust was moderate or severe in winter and spring wheat trials (Doling, *Agriculture, Lond.* 1968, **75,** 3-7). Doling pointed out that Cappelle Desprez, which possessed good resistance to the current races, occupied 80 per cent of the wheat acreage, hence the lack of overall economic importance of the rust during these years. However, it was found (1958-67) to be the most frequent and serious rust in cereal trials (Doling and Doodson, *Pl. Path.* 1970, **19,** 14-21) being (1956-66) most severe and frequent in those in southern central and eastern areas (Doling and Doodson, *Trans. Br. mycol. Soc.* 1968, **51,** 427-34). At the beginning of

the period under review Macer listed the races then known to be present in the U.K. and the cultivars on which they were most virulent (*Rep. Pl. Breed. Inst. 1962-3*, 9-14).

Hardly any **Black Stem Rust** (*Puccinia graminis* Pers.) was recorded in wheat crops other than in 1967 when it was quite common in the Eastern Region especially on spring wheat and was noted in the south-east. It remained of little or no consequence. **Brown Rust** (*Puccinia recondita* Rob. & Desm. f. *tritici* Erikss. & Henn.) was noted in wheat on the eastern side of the country in 1967 but seemed of minor importance. Doling reported it on spring wheat at trial centres (1958-67) in southern and central areas only of England but more generally on winter wheat, but it was infrequent and on only two occasions severe (*Pl. Path.* 1970, **19,** 14-21).

The **Powdery Mildew** (*Erysiphe graminis* Mérat) years were 1964, 1965, and 1968. For long the full significance of cereal mildew was unappreciated but it is now recognized that it probably causes more losses over the country as a whole than any other cereal foliage disease, though its worst effects are on barley and oats. On wheat (*E. graminis* Mérat f. *tritici* Marchal), 13 races were identified in surveys in the U.K. in 1961 and 1962 (Wolfe, *Trans. Br. mycol. Soc.* 1965, **48,** 315-26) and a further two in 1964 (Wolfe, ibid. 1967, **50,** 631-40).

Seed harvested in 1963 showed more **Glume Blotch** (*Leptosphaeria nodorum* Müller) than that harvested for several years past (Hewett, *Trans. Br. mycol. Soc.* 1965, **48,** 59-72); but in the field the disease aroused most comment from 1964 and was particularly prevalent in 1968. Its significance, at least in the south and west, seemed much greater than had once been thought: not only does it reduce yield but it also affects the suitability of grain for milling. In surveys of wheat samples harvested from N.I.A.B. cultivar trials the highest levels of *L. nodorum* were in samples harvested at trial centres in the west and south of England and Wales (Hewett, *J. natn. Inst. agric. Bot.* 1966, **10,** 602-8). The perfect stage of the fungus has now been recorded in England, the first time in Britain (Lucas and Webster, *Trans. Br. mycol. Soc.* 1967, **50,** 105). Also of more concern than previously was **Leaf Spot** (*Septoria tritici* Rob. apud Desm.), again particularly in the south-west of the country, where it was often common and sometimes severe. These *Septoria* diseases were the most serious foliage diseases of winter wheat in western areas.

Cultivar Rothwell Perdix was affected with **Halo Spot** (*Selenophoma donacis* (Passer.) Sprague & A. G. Johnson) at six sites in Dorset in 1966, and in one instance the disease was thought to be causing loss. These outbreaks were believed to be the first of the disease on wheat in Britain.

Ascochyta graminicola Sacc. has been recorded by Cook (*Pl. Path.* 1970, **19,** 48-9). He found the fungus on cv. Cappelle Desprez in Wilts in June 1967, causing lesions on the leaves, and again on cv. Joss Cambier in Dorset in May 1968. Later in the year, about 25 per cent of the Cappelle Desprez crop was affected by die-back of leaf tips and spotting. Early in 1968 the fungus was again noted on moribund leaf tips of Cappelle Desprez in Dorset. The fungus was also recorded on barley and these constituted new host records (*loc. cit.*) for this country; it was already familiar on grasses here.

The economic importance of **Take-all** (*Ophiobolus graminis* (Sacc.)

Sacc.) on some soils remained considerable. It was particularly prevalent in 1963, 1965 and 1966, especially 1965, and was prominent in some areas in 1964. The widespread phenomenon of take-all decline (Slope and Cox, *Rep. Rothamsted exp. Stn, 1963*, 108) was arousing interest, and a technique was developed for detecting and measuring inhibition of parasitic activity of the fungus in soils (Lester and Shipton, *Pl. Path.* 1967, **16**, 121-3). Take-all has been shown to be the major disease affecting yield in the east Midlands when two or more successive crops of winter wheat are grown (Rosser and Chadburn, *Pl. Path.* 1968, **17**, 51-60). **Eyespot** (*Cercosporella herpotrichoides* Fron) was most prominent in 1964 and 1967, but was widely prevalent in 1965 also, and in some areas in 1963. The very extensive cultivation of the eyespot-resistant cv. Cappelle Desprez wheat since the mid-'fifties had reduced the importance of this disease. **Sharp Eyespot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was seasonally widespread and common in some areas but even when prevalent it often had little effect on cropping. In the Midlands and north most was seen in 1963, 1965 and 1966, but in the south-west in 1962, 1965 and 1967. In an assessment of its economic importance in Britain, Pitt (*Ann. appl. Biol.* 1966, **58**, 299-308) concluded that the most serious effect is on establishment of the crop.

Brown Foot Rot (*Fusarium* spp.) was sometimes common in cereals particularly in the Midlands and to the north. Seed infection by *Fusarium nivale* (Fr.) Ces. (perfect state: *Calonectria nivalis* Schaffnit) had been low for several years but rose very considerably in 1963 (Hewett, *Trans. Br. mycol. Soc.* 1965, **48**, 59-72). Surveys of cereal crops in 1963 showed that *F. nivale* was by far the most common species of *Fusarium* causing disease in Yorks, Ches and counties in the Eastern Region (Colhoun, Taylor and Millar, *Nature, Lond.* 1963, **200**, 597). Other Fusaria detected in surveys of commercial seed samples harvested in 1959-63 were *F. avenaceum* (Fr.) Sacc., the most commonly detected; *F. tricinctum* (Corda) Sacc. f. *poae* (Peck) Snyder & Hansen, also common; and *F. culmorum* (W. G. Smith) Sacc. which was found relatively infrequently. Both *F. avenaceum* and *F. culmorum* attack wheat seedlings but *F. tricinctum* f. *poae* appears to be unimportant (Colhoun and Park, *Trans. Br. mycol. Soc.* 1964, **47**, 559-72).

The occurrence of the *Fusarium* stage (*F. graminearum* Schwabe) of **Scab** (*Gibberella zeae* (Schwein.) Petch) in a number of winter wheat crops in Hants in 1965 was unusual: the perithecial stage was present in two crops. *G. zeae* was noted also in a glasshouse in this country on rice plants.

Pythium Root Rot (*Pythium* spp.) was recorded on wheat in fields at Rothamsted and at two other sites in Beds and Suffolk respectively (Waller, *Rep. Rothamsted exp. Stn, 1967*, 139).

Cephalosporium Stripe (*Cephalosporium gramineum* Nisikado & Ikata) was first identified in this country in 1960 (see p. 11). In the following years its occurrence began to be recognized more widely. However, although widely distributed in this country, its economic significance usually appeared not to be great; and plants with stripe, though severely affected, are usually lightly scattered in the field. However, in 1968 it was considered to be the main cause of poor ears on cv. Cappelle Desprez in Berks. In the Yorks and Lancs Region in 1965 it was noted that infected plants were mostly round headlands and gateways.

Two distinct strains of *Rhizoctonia solani* Kühn, the imperfect state of

Corticium solani (Prill. & Delacr.) Bourd. & Galz., isolated from wheat stems, roots and stubble, were distinguished by morphological characters and pathogenicity (Elnur and Chesters, *Pl. Path.* 1967, **16**, 104-7).

After the appearance in 1959 of a race of **Loose Smut** (*Ustilago nuda* (Jens.) Rostr. f. *tritici* (Jens.) Schaff.) which attacked cv. Cappelle Desprez (see p. 11) a cultivar used extensively in breeding programmes, this disease became of more concern. It was particularly prominent in 1966 and was common in the next two years. **Bunt** (*Tilletia caries* (DC.) Tul.) was still very rare. **Ergot** (*Claviceps purpurea* (Fr.) Tul.), though common in wheat in the east in some seasons, remained of little general consequence. **Black Mould** (*Cladosporium* and *Alternaria*) on cereals sometimes worries farmers, as in 1967 in many parts of the Eastern Region and the trouble was noticeable in 1963 in the east of the country. **Grey Mould** (*Botrytis cinerea* Fr.) had apparently killed the florets on several wheat and barley cultivars in Yorks N.R., Northumb and Dur in 1968: the fungus was sporulating inside the glumes.

Drechslera siccans (Drechs.) Shoemaker was identified on Cappelle Desprez wheat grain, harvested in 1965 in Wales (MacGarvie, *Pl. Path.* 1968, **17**, 113-5).

Polymyxa graminis Ledingham has been recorded in roots of wheat grown in soil from a site in Norfolk (Macfarlane, *Rep. Rothamsted exp. Stn, 1966*, 131). The fungus had not previously been recorded in Britain. A fungus provisionally identified as *Lagena radicicola* Vanterpool & Ledingham was found in roots of wheat plants from Rothamsted farm (Macfarlane, ibid. 131-2): it had earlier been found on barley. According to Macfarlane (*loc. cit.*) the fungus, though not previously recorded in Britain, is likely to be widespread and probably important in cereal-root diseases.

A genetical leaf speckling can be common in Cappelle Desprez and other cultivars. Various symptoms are associated with **Frost Injury:** in February 1965 a fracturing of the outer leaf sheath and shoots of cereals, as though the tops had been chopped off at soil level was noted in the east Midlands. A similar severing of the primary shoots of wheat and barley has been noted in Scotland (Shaw and Blackett, *Pl. Path.* 1966, **15**, 119-20).

Barley

The big increase in the acreage put down to barley had led to greater interest in diseases. Intensive cereal cropping meant more attention to root diseases, and the increase of several diseases on the mildew-free foliage of mildew-resistant cultivars produced other problems.

The **Powdery Mildew** (*Erysiphe graminis* Mérat f. *hordei* Marchal) years were 1964, 1965 and 1968, while 1967 brought the outstanding breakdown of cv. Impala over the whole country. In 1967, infection was considerable in the top two leaves in many crops in the south-east especially where the highest amounts of nitrogen were applied. Wolfe has discussed the race position in f. sp. *hordei* in the U.K.: from its introduction in the early 1960's, Impala rose to occupy 15 per cent of the spring barley acreage by 1967, and the population of races able to attack it rose from nil in 1964 to 75 per cent of all the barley mildew samples investigated at the Plant

Breeding Institute in 1967 (*Pl. Path.* 1968, **17,** 82-7). The average loss of spring barley due to mildew over the 10 years up to 1968, as assessed from experiments and trials, has been put at 7 per cent (Doling, *Agriculture, Lond.* 1968, **75,** 3-7). Interest was developing in systemic fungicides to control mildew.

Brown Rust (*Puccinia hordei* Otth) appeared to be of small significance until 1966, though Macer and Wolfe reported it to be severe in the south in 1964 (*Rep. Pl. Breed. Inst. 1963-4,* 98). The 1966 season brought widespread and severe attacks in much of the south, with a similar situation developing the following year in the south-west. In 1967 it was conspicuous in several other areas also, mainly on the eastern side of the country, and in 1968 many parts of the country experienced attacks, some of them severe. The increase in significance of brown rust may have been associated with the introduction of cultivars of barley resistant to mildew.

The final year (1961) of the previous period had been notable for the amount of **Yellow Rust** (*Puccinia striiformis* Westend.): this followed many years in which the disease had been negligible. From 1961 the disease occurred increasingly throughout the country but the high resistance of many of the popular cultivars such as Proctor meant that it was not usually severe and was of consequence only in southern and western areas, where it was considered to be a potential danger to crops (Macer and Van den Driessche, *J. agric. Sci., Camb.* 1966, **67,** 255-65). In 1968 it was of little consequence.

Leaf Blotch (*Rhynchosporium secalis* (Oud.) Davis) was increasingly troublesome particularly in coastal areas or inland areas of high humidity. The expansion in acreage of mildew-resistant cultivars together with favourable weather conditions no doubt contributed to this increase. Losses caused by the disease have been assessed by James, Jenkins and Jemmett (*Ann. appl. Biol.* 1968, **62,** 273-88). Leaf blotch began to come into prominence in 1958 when observations on it were intensified. Barley crops were fairly commonly attacked in some southern areas in 1963 particularly in Devon and Cornwall, and the disease was locally severe in 1964. Infection was widespread throughout the country in 1965 and severe attacks were widely distributed. In the south-west, late sowings, as well as early ones, were substantially affected. In the following two seasons, though still widely distributed, leaf blotch was of much less consequence generally, though still severe in some areas. The disease was again widespread and frequently severe in the south-west in 1968 and locally severe elsewhere. Several races of *R. secalis* have been distinguished (Owen, *Trans. Br. mycol. Soc.* 1963, **46,** 604-8).

Prior to the period under review, reports of **Halo Spot** (*Selenophoma donacis* (Passer.) Sprague & A. G. Johnson) on barley from England and Wales were very few indeed. The fungus attacked several cultivars in a trial in Cornwall in 1963 and a few outbreaks were found in the south-west in 1964. From 1966 to 1968 halo spot was common in Devon and Cornwall but was severe in some crops only: it was also prevalent in Wales, where it often caused damage. Attacks were seen in some crops in northern counties in 1966. **Net Blotch** (*Pyrenophora teres* Drechsl.) has mostly been rare since organomercurial seed dressings have been adopted as a routine but the disease was seen in the south and in Wales in 1968 though it was of minor

importance only. Many crops of cv. Zephyr were affected. The development of net blotch from barley debris was studied in 1968 in the Wye Sub-Region (Evans, *Pl. Path.* 1969, **18,** 116-8). Another disease for long kept in check by organomercurials was **Leaf Stripe** (*Pyrenophora graminea* Ito & Kurib.): it had become rare outside Wales and the south-west. Its incidence increased markedly in 1967 and 1968 in the extreme south-west. In 1968 it was on the increase in the south-east also, and was present in every crop examined in mid-Wales. Some crops grown from seed dressed with fungicide were affected. **Leaf Spot** (*Septoria passerinii* Sacc.)* was seen in an N.I.A.B. trial in Kent in 1962 in which several cultivars were affected, in Devon in 1965, and in Anglesey in 1967. There were two earlier English records of a fungus closely resembling this species (Moore, *Br. Parasitic Fungi*, p. 362). Withered leaves and leaf tips in a crop of cv. Maris Otter, near the sea in Som, were abundantly infected with *Ascochyta graminicola* Sacc. in the early months of 1967 (Cook, *Pl. Path.* 1970, **19,** 48-9). This was a new host record for the fungus in the U.K.: only grasses had previously been found to be infected here, but wheat in Wilts was also affected in 1967 (*loc. cit.*).

The years in which **Take-all** (*Ophiobolus graminis* (Sacc.) Sacc.) and **Eyespot** (*Cercosporella herpotrichoides* Fron) were most prominent are mentioned under wheat. Take-all is less troublesome on barley than on wheat. **Cephalosporium Stripe** (*Cephalosporium gramineum* Nisik., Mats. & Yamanti) which had earlier been recorded on wheat (p. 11) was identified also in a few barley crops from 1963. **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was found in well-defined patches, up to 3 yd square, in a field of otherwise perfect cv. Proctor in Yorks in 1962. Affected plants were stunted and thin: every plant in the patches was attacked at the stem base and in the roots by the fungus. There had been no trouble in an immediately previous wheat crop but in the previous barley crop, four years earlier, the same trouble had been seen to a smaller extent. This root rot was seen in a crop in Lancs the same year. **Pythium Root Rot** (*Pythium* sp.) and **Snow Mould** (*Typhula incarnata* Fr.) were both noted, the latter in Lincs and Staffs. **Brown Foot Rot** (*Fusarium* spp.) is referred to under wheat p. 209.

Loose Smut (*Ustilago nuda* (Jens.) Rostr.) became more common in the last three years but **Covered Smut** (*Ustilago hordei* (Pers.) Lagerh.), controllable with organomercurial seed dressings, remained rare. *Botrytis* sp. was troublesome in some crops in the extreme south-west in 1963, apparently causing blackening and rotting of the grain under high humidity conditions. In northern counties in summer 1968, *Botrytis* was sporulating inside the glumes on the heads of several barley and wheat crops and appeared to have killed the florets. A similar condition in barley in the east Midlands that year seemed to be due to the infection spreading from withered stamens. *B. cinerea* was a major cause of decay of spring barley in the west Midlands in 1968 following widespread damage by grain aphids.

Polymyxa graminis Ledingham has been recorded in roots of barley and wheat grown in soil from Norfolk (Macfarlane, *Rep. Rothamsted exp. Stn, 1966,* 131). A fungus closely resembling *Rhizophydium graminis*

* but see Holmes and Colhoun, *Trans. Br. mycol. Soc.* 1970, **55,** 321-5.

Ledingham, which parasitises root hairs and other surface cells, was found in roots of barley grown in sand containing roots of diseased cereals from Suffolk (Macfarlane, *loc. cit.*).

Barley Yellow Dwarf virus was sometimes common. The 1966 season was the first in the Northern Region in which the disease was sufficiently prominent to attract attention and, as in some other areas that year, it was commonly seen there.

A condition, "yawning of glumes", in which individual flowers, usually half way up the ear, do not develop had been widespread in 1947 (Dillon Weston, Large and Earnshaw, *Agriculture, Lond.* 1947, **54,** 417-21) and occurred again in 1963 in barley crops in Berks and in 1965 in Bucks. In 1947 the symptoms had been attributed to high temperatures at the time the flowers were forming, namely the last week in May and the first week in June; conditions that were repeated in 1963 and 1965. The **Colour-banding** ('rugby-stocking') effect related by Wilcox to deep sowing (*Pl. Path.* 1958, **8,** 34-5) has been seen on occasions.

Oats

In contrast to barley, oats is now less widely grown than formerly.

The most interesting development among the established diseases was the detection of resistance to mercury in the **Leaf Spot and Seedling Blight** fungus, *Pyrenophora avenae* Ito & Kurib. Resistance was first shown in stocks of Scottish oats (Noble *et al.*, *Pl. Path.* 1965, **15,** 23-8). For many years organomercurial seed treatments kept the disease at low levels but in recent years it became noticeable that powder formulations were sometimes no longer effective in giving control. In 1964 there was the odd report from the north of infected crops grown from treated seed, and in 1966 it was common there in crops raised from treated seed of Scottish and Northumb origin and tests were showing that mercury-tolerant strains of *P. avenae* were already established in the Northern Region. In 1967-8, leaf spot was found in nearly all crops examined in the north, and a high proportion were infected with the mercury-tolerant strain (Bainbridge, *Agriculture, Lond.* 1969, **76,** 97-8). A survey in 1968 showed that mercury-tolerance was present in samples from all parts of England and Wales (Dickens and Sharp, *Pl. Path.* 1970, **19,** 93-4). Tolerance has also been reported from Northern Ireland (Malone, *Pl. Path.* 1968, **17,** 41-5).

Crown Rust (*Puccinia coronata* Corda var. *avenae*) was quite prominent in the extreme south-west in 1968. Physiologic specialization in **Powdery Mildew** (*Erysiphe graminis* Mérat) had not been reported in *Avena* spp. until Hayes and Catling (*Nature, Lond.* 1963, **199,** 1111-2) reported the isolation of two specialized races. Resistant cultivars are now being grown. **Septoria Leaf Spot** (*Leptosphaeria avenaria* Weber) was sometimes noticeable in Wales and the north.

A further outbreak of **Take-all** (*Ophiobolus graminis* (Sacc.) Sacc. var. *avenae* E. M. Turner) in Kent was reported in 1962, only three miles from the site of the first in the county (p. 18). **Cephalosporium Stripe** (*Cephalosporium gramineum* Nisik., Mats. & Yamanti), first recorded in this country in wheat in 1960 (p. 11), was confirmed in an oat crop in Wilts in 1963 and has since been noted in oats elsewhere on one or two occasions.

The rare **Snow Rot** (*Typhula incarnata* Fr.) caused patchiness in lighter parts of a field of winter oats in Salop in 1965. **Loose Smut** (*Ustilago avenae* (Pers.) Rostr.) and **Covered Smut** (*Ustilago hordei* (Pers.) Lagerh.) have remained rare since organomercurial seed dressings have been used regularly. **Brown Foot Rot** (*Fusarium* spp.) is referred to under wheat p. 209.

A virus closely similar to oat **Mosaic,** which is soil borne, was first seen in Britain in 1964 and 1965 in three crops of winter oats cv. Powys within a 10-mile radius (Macfarlane, Jenkins and Melville, *Pl. Path.* 1968, **17**, 167-70). A virus probably identical with that in Devon was seen in 1967 at the Welsh Plant Breeding Station, Aberystwyth (Catherall, ibid. 1970, **19,** 78-81). Also observed at W.P.B.S., and for the first time in Britain, was oat **Sterile Dwarf** virus (Catherall, ibid. **19,** 75-8). **Barley Yellow Dwarf** virus was common in some seasons and areas. In 1966 it attracted attention for the first time in the extreme north and was prevalent in some other areas.

Rye

Leaf Blotch (*Rhynchosporium secalis* (Oud.) Davis) was noted once or twice in the south-west. **Leaf Spot** (*Cochliobolus sativus* (Ito & Kurib.) Dastur) was noted in 1962 on winter rye at Trawscoed Experimental Husbandry Farm in Wales: in this country the fungus had previously been recorded on rye in 1944 (Moore, *Br. Parasitic Fungi*, p. 228) causing foot rot. Severe attacks of **Eyespot** (*Cercosporella herpotrichoides* Fron) in a crop of grazing rye in Suffolk in 1968 were associated with extensive lodging, particularly where liquid nitrogen fertilizers were used. Spring-sown crops were much less infected than those sown in autumn. Many seeds in a sample of English-grown rye examined at O.S.T.S. Cambridge in 1962 developed sclerotia of *Botrytis* in germination and glasshouse tests (P. D. Hewett, pers. comm.) and a proportion were either dead or gave weak seedlings.

In 1967 many acres of Hungarian grazing cultivars grown for seed in Suffolk were very badly lodged in August. Some straws showed **Sharp Eyespot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) lesions, and from the rotten bases of others, *Fusarium culmorum* (W. G. Smith) Sacc. was isolated: in other cases lodging was not attributable to any pathogen and was thought to be due to a weakening of the straws by late frosts in May.

Maize and Sweet Corn

In a trial at Harper Adams Agricultural College, Salop in 1963 some maize cultivars being grown for silage developed lesions on the stems which were found to be infected with *Rhizoctonia* sp. This was believed to be the first record of **Sharp Eyespot** of maize in this country (Knight and Burrell, *Pl. Path.* 1964, **13,** 138). There were odd records of **Smut** (*Ustilago maydis* (DC.) Corda) on sweet corn or maize from Kent, Norfolk, Worcs, I.W. and Essex between 1966 and 1968. **Foot Rot** (*Fusarium culmorum* (W. G. Smith) Sacc.) was noted in sweet corn and maize in 1968: it was noted also in rice in a glasshouse. *Botrytis* sp. was associated with lesions on sheathing leaves of cobs in a crop of maize in the Evesham Area in 1968, presumably

1. Symptoms of pelargonium leaf curl virus on pelargonium (pp. 190, 292).

2. Gladiolus flower showing the effects of cucumber mosaic virus (p. 179).

3. Freesia affected by freesia mosaic virus (p. 177).

PLATE XI

1. Symptoms of tobacco veinal necrosis virus on leaf of Epicure potato (p. 38).

2. Two King Edward potato tubers affected by 'stag'. The effect on tuber shape and stolons is shown (p. 219).

being encouraged by the poor growing conditions. It has been shown that maize can become severely infected with *Ophiobolus graminis* (Sacc.) Sacc. early in growth but that the infection seems not to be progressive (Robinson and Lucas, *Pl. Path.* 1967, **16**, 75-7).

Diseases of Potatoes

The **Blight** (*Phytophthora infestans* (Mont.) de Bary) years were 1963, to a lesser extent 1965 and, in east coastal districts only, 1968. Following its release to commerce in 1961, Pentland Dell had continued to be resistant and was becoming increasingly popular: however, in 1967, widely distributed outbreaks were reported in this cultivar, and in tubers from the 1968 crop there were severe losses in many areas. By the end of the period, 70 physiologic races of *P. infestans* were known to occur in Britain (Malcolmson, *Trans. Br. mycol. Soc.* 1969, **53**, 417-23).

The seven years started (1961/2 winter) with an oustandingly bad year for **Skin Spot** (*Oospora pustulans* Owen & Wakef.) Many Scottish consignments, particularly of King Edward, were badly affected in the eyes, with gappiness resulting after planting. The disease was prominent again in 1963 though rather less so. Though variable, it remained an important disease in the remaining years but was rather less in evidence in the 1966/7 winter. Surveys of skin spot and other fungal diseases in seed tubers continued through the period by workers at Rothamsted and the results have been summarized in the annual reports of that station.

Gangrene (*Phoma exigua* Desm. f. *foveata* (Foister) Malcolmson & Gray) was the main cause of loss in stored tubers, and the most troublesome disease in seed. Though variable in severity, it was widespread in all years. In a survey of soils for the presence of *P. exigua*, half the English soils were found to contain the fungus (Malcolmson and Gray, *Ann. appl. Biol.* 1968, **62**, 77-87).

Dry Rot (*Fusarium caeruleum* (Lib.) Sacc.) has not often been a problem but was said to be increasing in importance in the south-east in 1967. Most **Pink Rot** (*Phytophthora erythroseptica* Pethybr.) developed in eastern areas in 1964 and the 1967/8 winter. *Phytophthora megasperma* Drechsl. (see p. 30) was found in rotting tubers of cv. Ulster Chieftain in two irrigated crops in the south-west. **Stem Canker** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was often troublesome and a common cause of gappiness: the 1964 season was the worst but it was prominent in the north in 1965 and in eastern areas in 1968.

There was more **Common Scab** (*Streptomyces scabies* (Thaxt.) Waksm. & Henrici) in 1967 than in any other year, but it was notably widespread in much of the country in 1964. The causal organism can be regarded as a single strain of *S. scabies* (Jones, *Pl. Path.* 1965. **14**, 86-8).

Powdery Scab (*Spongospora subterranea* (Wallr.) Lagerh. f. *subterranea*) mainly drew attention in the north and west by its effect on Pentland Crown which proved particularly susceptible to the severe canker form. In the Northern Region in 1968 it was extremely difficult to find stocks of this cultivar free from it. The status of **Wart Disease** (*Synchytrium endobioticum* (Schilb.) Perc.) remained as in recent years, with few farm outbreaks recorded and no evidence of the existence of any race other than the common European race, but the status of **Verticillium Wilt** has needed re-examination. More than two-thirds of the crops in approximately 650 acres exam-

ined in eastern England in 1967 yielded *V. dahliae* Kleb. and some were extensively and severely damaged (Isaac and Harrison, *Ann. appl. Biol.* 1968, **61**, 231-44). From this work (*loc. cit.*) it seemed that the disease, perhaps more appropriately called early-dying disease, was more widespread in this country than had been thought; moreover, *V. dahliae*, *V. alboatrum* Reinke & Berth., *V. nigrescens* Pethybr. and *V. nubilum* Pethybr. were all shown to be pathogenic. The incidence of *Verticillium* in seed stocks has also been investigated. *Verticillium* spp. were isolated from 79 per cent of 225 stocks in 1965 but *V. alboatrum* and *V. dahliae* were not found (Macgarvie and Hide, *Pl. Path.* 1966, **15**, 72-5). The predominating species was *V. tricorpus* Isaac, with *V. nubilum* and *V. nigrescens* also present in many stocks.

After an absence from reports from this country for nearly 20 years, **Rubbery Rot** (*Oospora lactis* (Fres.) Sacc.) was found in the early ware crop in Pemb in the 1967/8 season (Humphreys-Jones, *Pl. Path.* 1969, **18**, 186-7). **Stalk Break** (*Sclerotinia sclerotiorum* (Lib.) de Bary), absent from reports for some time, appeared on the odd occasion. **Root Rot** was attributed to *Pythium* sp. or *Corticium solani* (Prill. & Delacr). Bourd. & Galz. in one or two instances.

In 1966, pycnidia of a species of *Septoria* occurred widely on the haulms of cv. Majestic in a field in Som, being associated with light brown lesions which often girdled the stems, sometimes killing the foliage above. The *Septoria* was confirmed at C.M.I. where a species of *Leptosphaeria* was also obtained.

Powdery Mildew (*Oidium* sp.) see p. 35) was noted in a glasshouse in 1964.

Black Leg (*Erwinia carotovora* (Jones) Bergey *et al.* var. *atroseptica* (van Hall) Dye) incidence was surveyed by the Disease Assessment Committee of the Conference of N.A.A.S. Advisory Plant Pathologists in collaboration with Plant Pathology Laboratory, Harpenden. Field surveys over three years, 1966-68, indicated that the mean levels in all ware crops were about 1 per cent and 2 per cent for the July and August counts respectively and that the levels were of roughly the same order each year. The level in crops of cv. Majestic was about twice that in cv. King Edward. **Ring Rot** (*Corynebacterium sepedonicum* (Spieckermann & Kotthoff) Skaptason & Burkh.) and **Brown Rot** (*Pseudomonas solanacearum* (Smith) Smith) were again intercepted in a few imported consignments but neither disease has ever been confirmed in field crops in this country. *Pseudomonas syringae* van Hall was isolated from blackened midribs on leaves of cv. Ulster Glade in Cambs in August. Pre-packing of tubers in polyethylene bags has brought its' problems: under some conditions greatly increased rotting has been experienced by many packers (Scholey *et al.*, *Pl. Path.* 1968, **17**, 135-9).

The significance of aphid-borne virus diseases remains at a more favourable level than formerly following the continued widespread use of certified seed and has been overshadowed by the importance of the latent seed-tuber diseases caused by fungi. The development of attacks by potato **Leaf Roll** virus in Yorks E.R. in 1962-4 (Fidler *et al.*, *Pl. Path.* 1967, **16**, 97-103) and Yorks N.R. in 1964-6 (Rogerson and White, ibid. 1969, **18**, 156-63) has been studied in relation to aphid infestation in these areas.

Soil-borne virus diseases have been of interest. A previously unrecorded virus, potato **Mop-top,** transmitted by *Spongospora subterranea* f. *subterranea*

was found in most commercial stocks though often at a low level (Calvert and Harrison, *Pl. Path.* 1966, **15**, 134-9). In 1968, **Spraing** (tobacco rattle virus) was frequent in Pentland Dell, an increasingly popular cultivar, and has caused concern as a reason for rejection by ware merchants. The mop-top virus causes spraing symptoms in some cultivars (Calvert and Harrison, *loc. cit.*). Tuber infection by **Tobacco Necrosis** virus has been reported from England (Todd, *N.A.A.S. q. Rev.* 1967, No. 77, 21-9). Current knowledge about the soil-borne viruses of potato was reviewed by Todd (*Rep. Scott. Pl. Breed. Stn, 1965*, 209-35).

A condition resembling the virus disease spindle tuber has been found in crops of cv. Redskin in England (Cammack and Richardson, *Pl. Path.* 1963, **12**, 23-6) but further tests (Cammack, ibid. 1964, **13**, 69-72) led to the conclusion that the tuber abnormality was not caused by potato spindle tuber virus, which has still not been recorded in England and Wales. Sixteen per cent of nearly 2,000 crops of Redskin grown for seed or ware in the autumn and winter of 1962-3 contained the typically misshapen tubers (Cammack, *loc. cit.*).

Little Potato was quite common particularly in cv. Pentland Dell and reports of the **Coiled Sprout** condition (p. 41) were numerous. **Gemmation** was noted.

The hard winter of 1962-3 brought many crop problems. In potato tubers **Frost Injury** and **Chilling** were frequent. Symptoms of frosting varied but included vascular necrosis, chocolate-brown and grey-black areas in the flesh, shallow depressions on the skin with thin underlying discoloured areas, mostly blackish and wet in texture. In some instances the surface was not depressed but an irregular diffuse discoloration of the skin with underlying discoloured tissue occurred. The skin pitting which was frequently seen in some areas arose from localized killing of surface tissues followed by desiccation: this symptom, associated with frosting, was thought to be favoured by the generally dry atmospheric conditions during the winter.

Mechanical Injury still causes heavy losses. A survey in Britain in the autumn, winter and spring of 1961/2 showed that nearly two-thirds of maincrop potatoes leaving farms had been injured in some way and that in half of these the damage was deeper than was removable in a single peeling (Twiss and Jones, *Eur. Potato J.* 1965, **8**, 154-72). This survey found that only about 65 per cent of the weight of maincrop put into bulk storage was eventually saleable: losses through rotting amounted to about 15 per cent. Internal discoloration was found in all crops and, in some, affected one-third of the saleable ware.

Growers in Pemb who bought cv. Red Craigs Royal seed from a seed grower who had treated the crop with a pre-emergence spray of a proprietary formulation of dalapon found that pale green instead of red sprouts were produced. It appeared that the spray had removed the red pigment from the subsequent seed crop. Stunting, epinasty of leaves, rolling of leaflets and distortion of the growing point in several rows along the edge of a crop of cv. Red King was attributed to **Coal Gas Injury,** the gas escaping from a nearby main.

'Stag' tubers (see Cox, A. E., *The Potato. A Practical and Scientific Guide*, 1967, p. 111, London: W. H. & L. Collingridge) were noted in a few crops of cv. King Edward. The symptoms as described from the Eastern Region

included pallor of plants, woody stems, abundant flowers and large numbers of poorly-shaped wild-looking tubers with long drawn-out stolon ends (Plate XII, 2).

Diseases of Roots and Fodder Crops

Sugar Beet

Downy Mildew (*Peronospora farinosa* (Fr.) Fr. f. *betae* Byford) is mainly of importance in areas such as S. Lincs and W. Norfolk where root crops are grown near beet seed crops, or in the vicinity of mangel crops. From the early 1950's the disease decreased in significance but, later, various factors tended to favour it and incidence rose once again (Byford and Hull, *Ann. appl. Biol.* 1963, **52**, 415-22). In 1964 the mildew was widespread in East Anglia. The outstanding year was 1965, when much of the early summer stayed cool and damp; it was the worst year since 1957. Half the acreage of English beet was affected, more than 6,000 acres being severely attacked but the outbreak was confined to the eastern counties (Byford and Hull, *Ann. appl. Biol.* 1967, **60**, 281-96); Byford, *Br. Sugar Beet Rev.* 1969, **38**, 23-6). The two following years confirmed its importance in the susceptible areas.

Powdery Mildew (*Erysiphe betae* (Vañha) Weltzien) had declined in significance in the early '60's but it increased in 1964 and was very common in the later years in some areas of East Anglia. Dr. Hull has pointed out (pers. comm.) that in the 1930-60 period cleistothecia of the mildew were never found; yet more recently, both in the field and in the glasshouse, mildewed plants are covered with them and they are obvious to the naked eye as a peppering of black dots on the infected leaves.

Leaf Spot (*Ramularia beticola* Fautr. & Lamb.) was particularly noticeable in root crops in East Anglia in 1967 and 1968 and **Rust** (*Uromyces betae* Kickx) in 1967. **Black Leg** (*Pleospora björlingii* Byford) seemed most troublesome in 1967 and 1968. The occurrence of *Alternaria* spp. on sugar beet leaves infected with yellowing viruses has led to investigations on control measures (Russell, *Ann. appl. Biol.* 1965, **56**, 111-8; 1966, **57**, 425-34). *Polymyxa betae* Keskin has been found in roots of sugar beet in Norfolk (Macfarlane, *Rep. Rothamsted exp. Stn, 1965*, 122), and a fungus very similar to *Rhizophydium graminis* Ledingham in beet grown in soil from Norfolk (Macfarlane, ibid. *1966*, 131).

The incidence of **Virus Yellows,** caused by the beet mild yellowing (Russell, *Nature, Lond.* 1962, **195**, 1231) and beet yellows viruses (BMYV and BYV), was low in 1962-7, and only moderate amounts, increasing considerably in late August/September, developed in 1968. The Spray Warning Scheme (Hull, *Pl. Path.* 1968, **17**, 1-10) in conjunction with the widespread use of systemic insecticides (Hull and Heathcote, *Ann. appl. Biol.* 1967, **60**, 469-78) and hygiene measures helped to keep this potentially serious disease in check. The 1962 incidence, at the end of August, was the lowest since records began in 1946. BMYV occurred much more widely than BYV in the root crop and is the more important economically (Russell, *Pl. Path.* 1965, **14**, 95-101; *Br. Sugar Beet Rev.* 1968, **37**, 77-84). The recognition of BMYV, and of its prevalence, involved reconsideration of the earlier estimates of losses of beet due to yellows, as suggested, for example, by Ribbands (*Nature, Lond.* 1962, **195**, 1230-1).).

Annual incidence of yellows has been related to weather variations (observations 1940-65, Watson, *Pl. Path.* 1966, **15**, 145-9; and in relation to forecasting, 1942-64, Hurst, ibid. 1965, **14**, 47-53) and possibly even to sunspot activity (1946-64, Gibbs, ibid. 1966, **15**, 150-2). Other aspects given attention were the overwintering of aphids and viruses in sugar beet seed crops in 1963-6 (Heathcote, ibid. 1967, **16**, 126-30) and the host range of English isolates of the yellowing viruses (Russell, *Ann. appl. Biol.* 1965, **55**, 245-52).

Docking Disorder (see p. 51) was more apparent than usual in the eastern areas in 1962 and even worse in 1963 and 1964; most failures were on light sandy soils. In 1967 there was more than ever before with big areas of beet stunted following very wet conditions in May. The nematode-transmitted viruses **Tobacco Rattle** and **Tomato Black Ring** have been associated with stunted beet crops in East Anglia (Gibbs and Harrison, *Pl. Path.* 1964, **13**, 144-50), but little of the stunting associated with docking disorder seemed attributable to virus infection (Heathcote, ibid. 1965, **14**, 154-7). Docking disorder can probably be caused by several agents or conditions (e.g. see Daniels, ibid. 1965, **14**, 69-73), but nematodes seem to play a large part (p. 51).

The beet **Yellow Net** virus, first suspected in England in 1950, has been studied at Rothamsted (Watson, *Ann. appl. Biol.* 1962, **50**, 451-60).

Speckled Yellows (manganese deficiency), **Magnesium Deficiency** and **Heart Rot** (boron deficiency) were widespread in 1964 and 1965. **Iron Deficiency** developed in scattered plants in a few crops on chalky soils in the south and east in 1963. A new disorder was seen in 1967; in some ways it resembled strangles but the tap root was twisted and sometimes had broken below ground level. The condition has since been attributed to damage by various herbicides applied to the soil (Boyd *et al.*, *Pl. Path.* 1970, **19**, 163-4).

Mangel

The main diseases followed the rises and falls in incidence in sugar beet. The only disease worth mention here is **Cucumber Mosaic** (virus) which was confirmed in several lots of stecklings in Holland (Lincs) in 1964 and the seed crops the following year were so severely affected that they were ploughed in. Severely affected seed crops were seen in Norfolk too in 1965.

Turnip and Swede

Club Root (*Plasmodiophora brassicae* Woron.) is particularly important in swedes and turnips, in which it is serious and common, as no chemical control measures are known. Races N1, N2 and N3 have been differentiated using *B. napus* genotypes (Johnston, *Pl. Path.* 1968, **17**, 184-7). **Dry Rot and Canker** (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) was increasing in severity in Wales and becoming as destructive as club root. In 1964, **Powdery Mildew** (*Erysiphe cruciferarum* Junell) was widespread in many areas. Also often reported during the seven years were **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) and **White Spot** (*Cercosporella brassicae* (Fautr. & Roum.) Höhnel). Swedes in trials at two places in Glam were infected by **Ring Spot** (*Mycosphaerella brassicicola*

(Duby) Oudem.). **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was becoming troublesome by 1962 in Som: the shallow depressions it caused were shiny brown and had purple rims. Below the lesion was a dry rot and *Rhizoctonia* was isolated from these rotted tissues. *Rhizoctonia* was also reported to cause **Wire Stem** in swede, and death of young turnips. **Black Rot** (*Xanthomonas campestris* (Pammel) Dowson) caused leaf spotting on swedes at a site in the south-west.

Turnip Mosaic, Cabbage Black Ring Spot (strain of turnip mosaic virus) and **Cucumber Mosaic** viruses were recorded. **Turnip Mild Yellows** virus has been under investigation at Rothamsted (Watson, *Rep. Rothamsted exp. Stn, 1962*, 1112; *1963*, 104; *1966*, 119-20). **Turnip Crinkle** virus (see p. 55) was identified in 1962 in swedes in the intensive swede growing areas of the Quantocks in Som.

Kale and Rape

Club Root (*Plasmodiophora brassicae* Woron.) was serious and common in rape, and the need for a chemical control was felt. Some serious attacks on kale were recorded. Also commonly reported were **Ring Spot** (*Mycosphaerella brassicicola* (Duby) Oudem.) and **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.). **White Spot** (*Cercosporella brassicae* (Fautr. & Roum.) Höhnel) affected rape crops. **Grey Mould** (*Botrytis cinerea* Fr.) was noted on pods of oil seed rape in the south-east, being associated with damage by weevils, and caused severe leaf spot and leaf rotting of a kale crop in Yorks apparently following frost injury. **Violet Root Rot** (*Helicobasidium purpureum* Pat.) had affected roots of marrow stem kale in a crop, suffering from nitrogen deficiency, in Berks in 1963: the 'corps miliares' were conspicuous on the roots of occasional plants from the field. No records of the fungus on brassicas in this country could be traced. Marrow stem kale plants affected by **Bacterial Leaf Spot** (*Pseudomonas maculicola* (McCulloch) Stevens) were noted in Cards in 1964 and in Cambs and Essex in 1967. A crop of cv. Maris Kestrel kale was extensively affected by soft rotting caused by *Pseudomonas* sp.

Diseases of Pulse

Field and Broad Beans

More beans were being grown: the increased interest in field beans as a break crop in the sequence of cereals has focussed attention on bean diseases.

Leaf Spot (*Ascochyta fabae* Speg.) (Plate XIV) has been a familiar disease for many years but until recently has not been regarded as of particular consequence. In 1965 there was concern about a dozen or so outbreaks in tic beans in Herts; nearly all were connected with one source of seed. Other attacks that year were noted in the east Midlands and Kent. The following year, several Regions reported quite a few outbreaks, some of which were severe. Examination of some stocks at O.S.T.S., Cambridge during 1964-6 revealed heavy infections (Hewett, *Pl. Path.* 1966, **15**, 161-3) but most commercial samples were clean. The greatest prominence in the field was in 1967 when the disease was fairly widespread throughout the country, with a few crops in most areas severely affected: in the east Midlands few crops appeared free from it. In an N.A.A.S./N.I.A.B. cultivar trial in Pemb, all cultivars were severely attacked. In the Wye Sub-Region, leaves and stems on every plant in 12 acres of cv. Spring Minor tic beans were affected, and more than half of the seed was infected to a greater or lesser degree. In N. Wales a number of crops being grown on a trial basis were damaged: the particularly extensive infection in Angelsey put the economics of the crop in the area in question.

Again, in 1968, many crops throughout the country were infected but on the whole not severely. In southern counties, pod infection was rather more apparent than leaf infection. At O.S.T.S. (*Rep. natn. Inst. agric. Bot. 1968*, 66) almost half of the field bean samples examined were found to be infected, and 40 per cent of them carried 4 per cent or more of infected seeds.

The disease not only affects yields adversely but the contents of affected pods can be used neither as seed nor for processing.

The 1968 season must be singled out for special mention of **Chocolate Spot** (*Botrytis fabae* Sardiña and *B. cinerea* Fr.). In some of the immediately preceding years this disease had tended to be overshadowed by *Ascochyta*, but in 1968 the reverse was the case. In the west Midlands many winter bean crops were devastated, pods were often not produced and crops were ploughed in. In the east Midlands the disease continued to develop throughout the summer, and by late August many crops had been defoliated. In the Eastern Region the epidemic was noticeable by May, and crops later suffered to a degree uncommon in the Region. Severe attacks developed throughout the southern counties; some winter crops in the south-east were ploughed in but spring-sown crops in the south were badly attacked also. In the extreme north the disease was variable.

A species of *Fusarium* has been noted in earlier years, causing a **Foot Rot** and **Root Rot** in various parts of the country (Moore, *Br. Parasitic Fungi*, p. 162). No reports were received during 1957-61, but at least a few attacks were recorded in each of these latter seven years. Most crops in Hunts and

Essex were affected in 1957 and the fungus seemed to be killing plants in patches in some crops. Several crops in the east were attacked in other years, also in the Evesham area, the Wye Sub-Region and occasionally elsewhere. In 1968 the trouble was commonly seen in the east Midlands and was often associated with waterlogging. In individual instances in the Evesham Area and Carms, the fungus was said to be *Fusarium solani* (Mart.) Sacc. A fungus regularly isolated from diseased broad bean plants in Worcs, and sent to the late Dr. W. Buxton, was considered by him to be in the *F. roseum* group. Apart from rotting of roots and the bases of stems, the symptom most commonly mentioned in reports was wilting. Both broad and tic beans are affected.

Of particular interest, in view of the scarcity of records from elsewhere in the world, was the finding of **Downy Mildew** (*Peronospora viciae* (Berk.) Casp.) in six broad bean crops in the Romney Marsh area of Kent and Sussex between June 25 and 17 July 1962. An account of these scattered outbreaks has been given by Glasscock (*Pl. Path.* 1963, **12**, 92). The few previous records of this fungus on broad bean were given by Moore (*Br. Parasitic Fungi*, p. 238). Several further outbreaks of the mildew occurred in the same area in 1963, 1964, 1965 and 1966. A severe attack was seen in Lincs in 1967, while, in 1968, reports of individual field bean crops affected came from Yorks E.R., Lincs and Suffolk. **Root Rot** (*Aphanomyces euteiches* Drechsl.), though widely distributed on peas, has rarely been recorded on beans. Moore (*Br. Parasitic Fungi*, p. 57) refers to only two reports of infection on broad beans, and no reports were received during 1957-61. The fungus was found in roots of broad bean plants suffering from root or foot rot on six farms in Norfolk, Suffolk, Essex and Yorks during 1962-7 and was also confirmed in a garden in Cards. The only mention in reports of **Leaf Spot** (*Cercospora zonata* Wint.) during the last 12 years came in 1967 when the fungus was confirmed in cv. Maris Bead winter beans in a cultivar trial in Som. The infection was widespread but mainly confined to the lower leaves.

Pythium and *Phytophthora* spp. have rarely been associated with troubles in *Vicia* beans. In 1966 a whole broad bean crop was lost in Glam through **Root Rot** associated with the presence of a species of *Pythium*; the condition was probably aggravated by waterlogging. Damping-off in one instance in Lancs was attributed to *Pythium*. A species of *Phytophthora*, probably *P. megasperma* Drechsl., was producing profuse sporangia and oospores in blackened radicles of plants from a holding in I.W. early in 1967. Both *Pythium* and *Phytophthora* were isolated from field bean plants showing a black spongy rot at the stem base in 1968 (*Rep. Rothamsted exp. Stn, 1968*, 141). **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) had affected broad bean plants from Denbigh examined in 1968; and **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was recorded in winter beans in Essex and broad beans in Worcs, having rarely been seen on these hosts previously.

Gibbs, Giussani-Belli and Smith (*Ann. appl. Biol.* 1968, **61**, 99-107) have discussed **Broad Bean Stain** and **Broad Bean Mosaic** viruses. They obtained true broad bean mosaic virus, from broad bean plants with distorted leaves showing a chlorotic mosaic, in 1959 and 1960, but did not obtain this virus in 1965 and 1966. From other plants they isolated the similar but

distinct broad bean stain virus in 1960, 1965 and 1966. All plants came from the Evesham area of Worcs or from East Anglia. Lloyd, Smith and Jones (*Hort. Res.* 1965, **5**, 13-8) had recorded the symptoms of what was popularly known as "Evesham Stain" in 1959 and 1960 in the Vale of Evesham, and in 1960 in Beds and East Anglia. Aldrich, Gibbs and Taylor (*Pl. Path.* 1965, **14**, 11-4), in field plot studies, found that some cultivars of field beans consistently had more **Bean Leaf Roll** virus than other cultivars.

French and Runner Beans

More reports of **Leaf Blotch** (*Ascochyta boltshauseri* Sacc.) (see p. 59) in climbing and runner beans came, in 1962 and 1963, from Kent and East Anglia. The rare **Blotch** (*Ascochyta phaseolorum* Sacc.) was not recorded in 1957-61, but in 1965, pods in an outdoor runner bean crop in Denbigh were affected; and in 1967 a severe attack on the green type French bean cultivars The Prince and Tender Green occurred in Cornwall while speckled blue types cvs. Phoenix and Claudia on the same premises were not significantly affected. *Phoma diversispora* Bubák, and to a lesser extent *A. phaseolorum*, were identified in association with irregular, reddish-brown blemishes on pods of cv. Blue Lake climbing beans in summer 1968 in Worcs. The crop was devastated by the attack.

There was the odd record of **Grey Mould** (*Botrytis cinerea* Fr.) causing stem rot in climbing French beans and in runner beans; and one of **Root Rot**, attributed to *Pythium* sp., in climbing beans under glass in Flints in 1962. *Rhizoctonia* is mentioned on p. 59 as occurring in association with *Fusarium* in plants suffering from fusarium foot rot, but no outbreaks of root rot in this country appear to have been attributed to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. until recently. However, during 1964 there were three outbreaks in dwarf, climbing and runner bean crops respectively. Single outbreaks occurred in 1965 and 1968. Some of these attacks were extensive. **Verticillium Wilt** (*Verticillium* sp.) was recorded on runner beans in Cornwall in 1964: previously *V. dahliae* has been recorded on this host (p. 61).

Halo Blight (*Pseudomonas phaseolicola* (Burkh.) Dowson) was severe in many crops of runner and dwarf beans. The worst seasons were 1965 (Evesham area and southern counties) and 1968 (eastern and southern counties), and concern was caused in several areas. In other years it was locally prominent, being above average in 1963 in runner beans in the Eastern Region, serious in 1964 in parts of Norfolk, where early-sown dwarf bean crops had to be ploughed in, and in the south-east in runner beans, and severe in 1966 in the Evesham area. Epton and Deverall (*Pl. Path.* 1965, **14**, 53-4) showed that races 1 and 2 occur in the U.K. From an examination of isolates from outbreaks in southern England in 1964 and 1965, Wharton (ibid. 1967, **16**, 27-30) suggested that race 1 may be indigenous in runner bean crops but that race 2 had mainly been introduced in infected stocks of dwarf bean seed.

In 1965, *Pseudomonas viridiflava* (Burkh.) Clara was isolated from affected tissues of dwarf bean plants showing severe necrotic spotting in Berks in September. Four samples of cv. Canadian Wonder dwarf bean seed of unknown origin were found to be infected with **Fuscous Blight** (*Xanthomonas phaseoli* (Smith) Dowson var. *fuscans* (Burkh.) Starr & Burkh.) when they were examined in Scotland (Noble, C.P. *News*, 1962, **8**, 30).

Soybean

The first reports for this country of **Downy Mildew** (*Peronospora manshurica* (Naum.) Syd.) (Plate I, 1) are to be found on p. 61. This fungus was severe on a crop of a Canadian cultivar, Merit, in Essex in 1968, and was also seen on this cultivar at N.I.A.B., Cambridge. **Tobacco Ring Spot** virus was confirmed at Plant Pathology Laboratory, Harpenden on soybean plants grown for teaching purposes in Cards in 1966. The true leaves were puckered and otherwise deformed. This virus can have a high rate of transmission in soybean seed (Desjardins, Latterell and Mitchell, *Phytopathology*, 1954, **44**, 86).

Pea

There is little to comment upon among the fungus diseases of peas.

Downy Mildew (*Peronospora viciae* (Berk.) Casp.) and **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *pisi* (Lindf.) Snyder & Hansen and *F. redolens* Wollenw.) remained the major diseases, with **Leaf Spot, Pod Spot and Foot Rot** (*Ascochyta* spp.) and **Fusarium Foot Rot** (*Fusarium solani* (Mart.) Sacc. f. *pisi* (Jones) Snyder & Hansen) commonly reported. The perfect stage of *F. solani* f. *pisi* has now been identified as *Hypomyces solani* (Rke. & Berth.) Snyder & Hansen f. *pisi* Reichle, Snyder & Matuo (*Nature, Lond.* 1964, **203**, 664).

The sole new record was of *Verticillium dahliae* Kleb., which was isolated from plants dying in patches in a crop in Lincs in 1962. Verticillium wilt had not been recorded on peas in this country.

In 1962 and 1963, a form of **Pea Early Browning** virus occurred in many pea crops on sandy soils in Norfolk and Suffolk (Gibbs and Harrison, *Ann. appl. Biol.* 1964, **54**, 1-11). Harrison conducted further studies on this virus (ibid. 1966, **57**, 121-9). In 1968 the virus was confirmed in crops in Holland (Lincs) and I. of Ely; and was found in many crops on light land in Norfolk but the incidence was thought not to be high enough to have affected yield. **Bean Leaf Roll** virus very commonly caused top yellows in pea crops in the Eastern Region in 1968, but probably came too late to affect yields. The effect of **Clover (Red) Vein Mosaic** virus on yield of peas was studied by Varma and Gibbs (*Rep. Rothamsted exp. Stn, 1966*, 118). **Marsh Spot** (manganese deficiency) was noted in several samples in 1962 and was extremely severe in one Norfolk crop. One hundred acres of vining peas on skirt soils in W. Norfolk in 1965 were rejected for processing because of this condition. The disease was said to be unusually prevalent in 1964 (*Rep. Pea Grow. Res. Org. 1964*, 10). The symptoms and nature of the physiological condition **Hollow Heart** have been discussed by Perry and Howell (*Pl. Path.* 1965, **14**, 111-6).

Diseases of Pasture, Forage Crops and Turf

It has become increasingly realised that the fungus and virus diseases commonly affecting clovers and grasses reduce yields significantly and lead to considerable loss of nutritive value (e.g. Carr and Catherall, *Rep. Welsh Pl. Breed. Stn, 1963*, 94-100).

Clover

Most frequently encountered by advisers were **Rot** (*Sclerotinia trifoliorum* Erikss.) and **Phyllody** (clover phyllody virus).

There was a further record of **Verticillium Wilt** (*Verticillium dahliae* Kleb.) from I.W.: the disease had only recently been diagnosed in this country (p. 67). An isolate of the fungus from the field was pathogenic to all 10 strains of red and white clover tested by the Regional Plant Pathologists. The rarely recorded **Leaf Spot** (*Ascochyta trifolii* Bond. and Truss.) was identified in a crop in Hants while the occasional, but rather insignificant, **Ring Spot** (*Stemphylium sarciniforme* (Cav.) Wiltsh.) was noted in Cornwall and Berks.

Bacterial diseases in clover are unusual. In 1965, a **Leaf Spot** in a crop of red clover in Montgomery was attributed to *Pseudomonas syringae* van Hall (Oxtoby and Lelliott, *Pl. Path.* 1966, **15**, 129-30).

Apart from phyllody, virus diseases have received little attention previously but, during the period, surveys have been made of both white and red clover in permanent pastures in this country. Of 683 white clover plants from various parts of Britain which were examined at Rothamsted (Gibbs, Varma and Woods, *Ann. appl. Biol.* 1966, **58**, 231-40), 23 per cent were found to be infected. Most common were the clover (red) **Vein Mosaic,** clover **Yellow Vein** and, to a lesser extent, clover (white) **Mosaic,** viruses, all three occurring ing in all areas. **Arabis Mosaic** virus was fairly frequent but in the north and west only. Also identified were **Strawberry Latent Ring Spot** virus, which occurred in one per cent of the plants, and **Red Leaf** (stolbur virus) which was found in the odd plant only. Clover yellow vein virus was first distinguished in white clover in Surrey (Hollings and Nariani, *Ann. appl. Biol.* 1966, **56**, 99-109). Further information on the extent of viruses in white clover has been obtained (Varma, Gibbs and Wood, *Rep. Rothamsted exp. Stn, 1966*, 117). In addition to the viruses already mentioned they found clover **Witches' Broom** and **Bean Yellow Mosaic** viruses.

In the red clover surveys (Varma and Gibbs, *Ann. appl. Biol.* 1967, **59**, 23-30), **Pea Mosaic** virus was found to be common and widespread, while **Arabis Mosaic, Bean Yellow Mosaic,** and the clover (red) **Mottle** and **Vein Mosaic** viruses were also recorded.

Lucerne

Verticillium Wilt (*Verticillium alboatrum* Reinke and Berth.) (Plate XIII, 2) remained the oustanding problem. *V. dahliae* Kleb. was recorded in one instance in Essex.

Leaf Spot (*Leptos phaerulina trifolii* (Rostr.) Petr.), first recorded in lucerne a few years ago (see p. 70), was noted for the first time on this host in East Anglia in September 1965 when perithecia of the fungus were found in association with spots in a crop in Norfolk. *Fusarium* spp. have not previously been associated with diseases of *Medicago* spp. but, in 1965, **Foot Rot** in a second-year crop of cv. Eynsford in Salop was associated with *Fusarium* sp., though other fungi were present too.

In 1964, the first outbreaks of **Bacterial Wilt** (*Corynebacterium insidiosum* (McCulloch) Jenson) in this country were confirmed. Infection was discovered in breeding material at Cambridge, in a plant which had been raised at the Plant Breeding Institute, and at Hurley, Berks. The disease (Plate XIII, 1) was found also in a commercial crop of cv. Du Puits in Norfolk alledgedly grown from American seed. Further infection was detected in plots at the Cambridge breeding station in 1965 (*Rep. Pl. Breed. Inst. 1964-5*, 96) but no other outbreaks have been discovered since and the disease is thought to have been eradicated.

Pea Early Browning virus has been found to occur in lucerne in East Anglia (Gibbs and Harrison, *Ann. appl. Biol.* 1964, **54**, 1-11).

Sainfoin

Rot (*Sclerotinia trifoliorum* Erikss.), reputedly not uncommon but not mentioned in reports for some time, was noted in the odd crop during this period. **Verticillium Wilt** (*Verticillium* sp.) was reported from Glam: *V. dahliae* was recorded on this host in 1940.

Comfrey

The only disease reported on this host was **Rust** (*Melampsorella symphyti* Bubák) which heavily infected a crop in Oxon.

Grasses

Hosts of **Ergot** (*Claviceps purpurea* (Fr.) Tul.) not mentioned in Part I, but reported since, were crested dogstail, mat-grass (*Nardus stricta*) and purple moor-grass (*Molinia caerulea*). **Choke** (*Epichloe typhina* (Fr.) Tul.) was said to be very prevalent on perennial ryegrass in S. Wales in 1965, was severe on the odd crop of tall fescue, and noted on bent-grass, creeping soft-grass and *Poa* sp. Timothy and rough-stalked meadow-grass were mentioned as hosts of **Take-all** (*Ophiobolus graminis* (Sacc.) Sacc.), while ryegrass and timothy, extensively yellowed in permanent grass and leys in an area of Lancs in autumn 1963 and to a less extent the following autumn, had been attacked by the oat strain of take-all (*O. graminis* (Sacc.) Sacc. var. *avenae* E. M. Turner). In 1967, ryegrass plants from Denbigh, with whiteheads, showed distinct lesions bearing characteristic spores of the **Eyespot** (*Cercosporella herpotrichoides* Fron) fungus. The latter fungus appeared to be unrecorded on ryegrass in this country but has been found affecting ryegrass in Ireland (Cunningham, *Nature, Lond.* 1965, **207**, 1414-5). In several fields in the south-east in 1968, *Fusarium culmorum* (W. G. Smith) Sacc. was isolated from

roots of failing ryegrass, but the significance was not clear. **Typhula Blight** or **Snow Scald** (*Typhula incarnata* Fr.) (see Turf, p. 231) was recorded in agricultural grassland after the 1962/3 winter (Jackson, *J. Sports Turf Res. Inst.* No. 39, 27-8).

In Part I, the first records of **Leaf Blotch** (*Rhynchosporium secalis* (Oud.) Davis and *R. orthosporum* Caldwell) on ryegrass were of special interest. During the period under review, many reports of each species were received. *R. secalis* was noted in several ryegrass crops in the south-west and in Wales, and was noted in Yorks and Salop. Couch-grass was severely attacked by this fungus at one place in Glos in 1966. *R. orthosporum* was seen in several instances in the south-west and a few reports were received from the south-east, west Midlands and Northumb: this species was noted also on cocksfoot. In many instances, leaf tipping by these fungi was extensive and severe, and palatibility was also affected.

Perennial ryegrass has now been recorded as a host of **Leaf Fleck** (*Mastigosporium album* Riess.): the disease appeared in Norfolk in 1966 (Lacey, *Pl. Path.* 1967, **16**, 48). **Leaf Spot** (*Drechslera siccans* (Drechsl.) Shoemaker) was recorded on meadow fescue, and in patches of bent-grass in an old ley in Glam. Severe spotting and death of leaves of timothy cv. Oakmere in N.I.A.B. plots at Trawscoed, Wales in 1968 was caused by *Drechslera phlei* (Graham) Shoemaker) see p. 74); and there were two further reports, from Lincs and Essex respectively, of the rarely recorded leaf spot (*Heterosporium phlei* Gregory) of timothy. Also seen on timothy, on several occasions, was **Halo Spot** (*Selenophoma donacis* (Pass.) Sprague and C. G. Johnson). **Leaf Spot** (*Hadrotrichum virescens* Sacc. & Roum.), which is not uncommon on bent-grass, was newly recorded on ryegrass, affecting five per cent of a 6-acre crop in Denbigh. Also noted in reports was leaf spot (*Ascochyta graminicola* Sacc.).

Crown Rust (*Puccinia coronata* Corda) occurred on meadow fescue in several parts of the country and was quite often severe. This rust was noted also on timothy and cocksfoot in Herts and on bent-grass in the Evesham area. **Yellow Rust** (*P. striiformis* Westend.) and **Agropyron Rust** (*P. recondita* Rob. & Desm. f. *agropyrina* Erikss.) were both noted on couch-grass in Berks, **Brome Rust** (*P. recondita* f. *bromina* Erikss.) on false-brome in Cards, and **Black Stem Rust** (*P. graminis* Pers.) on meadow-grass and fiorin (*Agrostis stolonifera*). **Sheath Smut** (*Ustilago hypodytes* (Schlecht.) Fr.) was recorded on cocksfoot in Rutland in 1962. **Powdery Mildew** (*Erysiphe graminis* Mérat) had affected plants of sweet vernal-grass in a glasshouse.

Ligniera junci, a member of the Plasmodiophorales, was first suspected as a cause of serious injury to an economic grass species in September 1964 (Carr, *Rep. Welsh Pl. Breed. Stn, 1964*, 103; *1965*, 96-7). Italian ryegrass, and to some extent perennial ryegrass, were affected. However, although this organism was later isolated from rotting roots of Italian ryegrass dying-off in patches in the Yorks and Lancs Region, pathogenicity tests by the Regional plant pathologists could not confirm that *L. junci* was responsible for the failures. Another chytrid, a species of *Polymyxa*, was found in roots of diseased Italian ryegrass from an infested site in Suffolk (Macfarlane, *Rep. Rothamsted exp. Stn, 1966*, 131): *Polymyxa* had not previously been found in ryegrass roots in this country. The **Slime Mould** *Mucilago*

spongiosa Morgan was seen on one or two swards and can develop extensively if conditions are favourable.

In 1967, **Halo Blight** (*Pseudomonas coronafaciens* (Elliott) Stevens) was diagnosed in two isolated crops of S215 meadow fescue in Wilts. The bacterium was isolated from the elongated, purple-brown, angular, interveinal lesions which occurred on the two youngest leaves of the plants. Early in 1968, similar symptoms were noted in S215 crops at two other sites in Wilts, but the causal organism was not identified. **Yellow Slime Disease** (*Corynebacterium rathayi* (Smith) Dowson) was noted on cocksfoot plants in the Northern Region and in seed samples examined at O.S.T.S., Cambridge.

Only comparatively recently has knowledge been gained about the viruses affecting grass hosts: Carr has reviewed current information and listed 11 viruses (*Span*, 1968, **11**, 92-5).

The viruses mentioned in Part I of the present report were **Cocksfoot Streak, Barley Yellow Dwarf** (BYDV) and **Ryegrass Mosaic.** The influence of streak virus on growth of cocksfoot has now been studied (Catherall and Griffiths, *Ann. appl. Biol.* 1966, **57**, 141-8; ibid. 149-54). The importance of ryegrass as a reservoir of BYDV in ryegrass crops in this country has been emphasized by work at Aberystwyth (Catherall, *Pl. Path.* 1963, **12**, 157-60) and Cambridge (Doodson, *Pl. Path.* 1967 **16**, 42-5), and the effects of BYDV on ryegrass have received attention (Catherall, *Ann. appl. Biol.* 1966, **57**, 155-62). Ryegrass mosaic was believed to be the cause of a widespread condition in seed crops of S22 Italian ryegrass which has caused considerable anxiety in the South-eastern Region since it was first noted in 1965. Plants were severely mottled and necrosed and seed production was badly affected. A few plants in seed crops of S321 perennial ryegrass were also attacked.

Cocksfoot Mottle virus was described during this period (Serjeant, *Pl. Path.* 1964, **13**, 23-4; *Ann. appl. Biol.* 1967, **59**, 31-8). It has been seen very widely in the Midlands, the south, East Anglia and was also recorded in crops in Yorks N.R., and seems to be more prevalent and also more important than streak virus. Some of the earlier records of cocksfoot streak may have in reality been of mottle. Productivity can be seriously reduced (Catherall, *Rep. Welsh Pl. Breed. Stn, 1967*, 120). The epidemiology of mottle has been studied (Upstone, *Ann. appl. Biol.* 1969, **64**, 49-55).

Other viruses newly discovered during the seven years were **Phleum Mottle** (Catherall, *Pl. Path.* 1970, **19**, 101-3) in timothy, first seen in 1964, **Anthoxanthum Mosaic** (Catherall, ibid. 125-7) in sweet-vernal grass, first seen in 1965, and **Oat Sterile Dwarf** in ryegrass (Catherall, ibid. 75-8).

Four other viruses were mentioned by Carr (*Span, loc. cit.*) as affecting grasses in Britain; **Lolium Mottle** and **Wheat Striate Mosaic** (**European**) in ryegrass, **Tomato Black Ring** in ryegrass and meadow grass, and **Barley Stripe Mosaic** in most grasses. Lolium mottle had not been identified in England and Wales by the end of the period now being discussed.

Very many plants scattered throughout a field of S22 Italian ryegrass in N. Wales in 1965 were completely white. This **Albinoism** was attributed to cold temperatures. Affected plants turned green within a few days when potted and put into a glasshouse, but similar plants which remained outside turned green only when the weather became milder.

Turf

The most interesting disease during these years was **Typhula Blight** or **Snow Scald** (*Typhula incarnata* Fr.) which had not previously been recorded on turf in this country but which was recorded in both England and Scotland in turf and agricultural grassland after the severe 1962/3 winter (Jackson, *J. Sports Turf Res. Inst.* 1962, No. 38, 414; ibid. 1963, No. 39, 27-8). It appeared to be widely distributed in Britain. The following hosts were recorded (*loc. cit*): perennial ryegrass, rough-stalked and annual meadow grasses, cocksfoot, sweet vernal-grass, Yorkshire fog, brown top, creeping bents and creeping red fescue.

Ophiobolus Patch Disease (*Ophiobolus graminis* (Sacc.) Sacc. var. *avenae* E. M. Turner) was outstandingly common and a serious problem in fine and coarse turf grasses in 1967 (Handoll, *J. Sports Turf Res. Inst.* No. 43, 28-33) following three seasons with prolonged wet conditions and a mild winter.

Other troubles recorded were **Powdery Mildew** (*Erysiphe graminis* Mérat), **Crown Rust** (*Puccinia coronata* Corda), **Leaf Spot** (*Mastigosporium album* Riess), and **Slime Moulds** which were particularly common, particularly *Physorum* sp. in Cards in autumn 1968, and *Mucilago spongiosa* Morgan which made a playing field unsightly.

Diseases of Vegetables and Herbs

Globe Artichoke

Before 1965, *Itersonilia perplexans* Derx had not been recorded on this crop; but in July of that year it was identified on the scales of flower heads in a crop in Surrey, and when a few further crops were inspected in Kent widespread infection of flower heads was found (Cragg, *Pl. Path.* 1966, **15**, 47). The lesions were similar to those which the fungus causes on chrysanthemum petals. According to Cragg, photographs of artichokes showing similar symptoms are to be found in old culinary literature so the disease may have long been present in Britain.

Specimens of the *Itersonilia*-infected material were received at Plant Pathology Laboratory, Harpenden, where examination revealed another fungus also, *Ascochyta hortorum* (Speg.) Smith var. *compositarum* (see Plate V, 1). The latter is known to affect artichokes abroad (see Malencon, *Revue Mycol.* N.S. 1936, **1**, 165-75). Field symptoms attributed to this fungus were not seen until November 1965 (Cragg, *loc. cit.*).

In 1962, **Downy Mildew** (*Bremia lactucae* Regel) was identified on specimens from Devon; and the same fungus badly affected a crop in Jersey in summer 1967. Previous records had come only from Sussex (1945) and Cornwall (1956).

Jerusalem Artichoke

Black Scurf (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was noted in 1962—a new host record. The affected tubers were examined in the South-eastern Region, and typical colonies of *Rhizoctonia solani* developed from sclerotia on agar plates.

According to Moore (*Br. Parasitic Fungi*, p. 344) **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) used not to be uncommon in southern counties in field and stored tubers. However, the sole record for 1957-61 (p. 78) is joined only by the occurrence over two successive seasons (1967-8) of severe infection in a small crop in Glos.

Asparagus

Die-back, attributed to *Botrytis cinerea* Fr., was reported in I.W. in 1965. Previously, this fungus had been recorded as causing death of stem tips (1931) and severe damage in seedling beds (1956). Two fungi, *Botrytis tulipae* Lind and *Phoma glomerata* (Corda) Wollenw. & Hoch, were associated with premature die-back of bowers in Dorset in September 1968. The site was deficient in boron and copper, but the stem bases bore extensive, elongated, chlorotic areas, and with these, and with dead stipules, were associated sclerotia of the *Botrytis*. The *Phoma*, also, was associated with chlorotic areas on bases of stems. Identifications of both fungi were confirmed by C.M.I., Kew.

On asparagus, an unidentified species of *Fusarium* has long been known to

be associated with root rot in several counties, but its pathogenicity has been in doubt. During 1962-8, *Fusarium* sp. was found to be variously associated with death of crowns, chlorotic and stunted foliage and brown lesions on the roots, in single crops in Worcs, War, Suffolk and N. Wales respectively. The first suggestion that *F. oxysporum* might be responsible for disease in asparagus came in 1959 from Suffolk (p. 78). In Hants at the end of 1965, *F. oxysporum* Fr. was isolated from plants whose foliage was chlorotic and browned: in this instance the identity of the fungus was confirmed by C.M.I., Kew.

Root Rot (*Pythium* sp.) was associated with uneven growth, and in some instances complete failure of patches, in a crop on Oxon in August 1965. *Pythium* was noted in 1936 in the basal parts of asparagus in Herefs (Moore, *Br. Parasitic Fungi*, p. 321). **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was also reported (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 5).

Hydrocooled prepacked tips suffered **Soft Rot** (*Pseudomonas* sp.) in I.W. in 1968; no trouble being experienced in open bundles.

Beetroot

No mention could be found of *Fusarium* affecting beetroot though *F. culmorum* (W. G. Smith) Sacc. is known as an occasional cause of rot of sugar beets. In 1964, in a store in the Yorks and Lancs Region roots rotted progressively, through the central tissues from the root, up towards the crown. Though blackened, the core remained firm. *F. culmorum* was consistently isolated. During growth, this crop had shown marked magnesium deficiency but had been sprayed with Epsom salts on three occasions to correct this. A species of *Fusarium* associated with mechanical damage was found in rotted roots in the Evesham Area early in 1966. In summer 1968, *F. culmorum* was recovered from seedlings in Worcs: the plants were stunted and the fungus was present on roots which did not swell. Red beets had been grown on this land for five consecutive years.

A report of **Violet Root Rot** (*Helicobasidium purpureum* Pat.) was received in 1967. Although not specifically mentioned by Moore in *Br. Parasitic Fungi* (1959) and not recorded in 1957-61, it is accepted that this disease occurs on garden beet (e.g. Ogilvie, *Diseases of Vegetables; Bull. Minist. Agric. Fish. Fd*, No. 123, 1969, p. 11) as well as on sugar beet and other related crops. In summer 1968 a species of *Pythium* was isolated from seedlings from a crop in Lancs which had emerged poorly and was dying off. *Pythium* spp. commonly cause black leg in sugar beet and mangels.

Diseases not mentioned in Part I but which occurred during 1962-8 were **Cucumber Mosaic** virus, which was confirmed in Beds in 1968, **Strangles** (non-parasitic) which affected half of an acre crop in Surrey in 1964, and **Magnesium Deficiency** which was noted on a few holdings in the Evesham Area.

Brassicae

Reports from Beds in 1963 indicated the highest level of **Club Root** (*Plasmodiophora brassicae* Woron.) there for many years. The disease was recorded in kohl-rabi in Dorset.

An effect of **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) on cauliflower curds, first seen in 1962 in Devon, was described by Jenkins (*Pl. Path.* 1964, **13**, 46). The curds showed a pale brown discoloration, the stems had black spots and streaks and, internally, a blackening mainly near the curd. Somewhat similar symptoms were observed in cauliflowers at Efford, Hants in 1962: hyphae of *P. parasitica* were systemic throughout the stem of the flower head producing a grey discoloration but there appeared to be no association with a browning on the curds, which might have been caused by midges. In Devon, plants of the Flora Blanca group were affected, and those of cv. Majestic were not; however, in Hants cv. Lucifer was mainly affected, cv. Autumn Giant moderately so, cvs. Majestic and Nova only slightly while Flora Blanca remained undamaged. A further instance of curd discoloration and stalk necrosis was recorded in 1965.

The amount of the **Canker** organism, *Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn., in brassica seed was causing concern (*Rep. natn. Inst. agric. Bot.* 1967, 54). Following the discovery that *Leptosphaeria maculans* was the ascogenous state of *P. lingam* in Australasia, it was successfully searched for at Rothamsted (Smith and Sutton, *Trans. Br. mycol. Soc.* 1964, **47**, 159-65). **Ring Spot** (*Mycosphaerella brassicicola* (Duby) Oudem.) and **Wire Stem** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) were among the more prominent diseases.

The incidence of **White Blister** (*Albugo candida* (Hook) O. Kuntze) depends very much on the season and, of these seven years, 1967 stood out from the others. In September it was the most prominent disease on Brussels sprouts in the Evesham Area and growers became very concerned, as inflorescences, foliage and sprouts were all affected and many cultivars were involved. No field immunity was noted. In an interesting occurrence in 1968 in the Evesham Area, two Brussels sprout crops cv. Early Half Tall were unfit to market because of enations inside the sprouts attributed to white blister.

An unfamiliar symptom associated with the **Dark Leaf Spot** fungus, *Alternaria brassicicola* (Schw.) Wiltsh., was investigated in the Wye Sub-Region in 1968. A speckling on cv. Gravendeel Brussels sprout buttons had made them unacceptable for deep freezing. A fungus isolated from necrotic tissues produced spores indistinguishable from those of *A. brassicicola* but inoculations with it were inconclusive.

Pleospora herbarum (Fr.) Rabenh. causes **Leaf Spot** on a number of vegetable and other hosts, but there were no records on brassicas in this country until January 1968 when it was confirmed on necrotic foliage of several cabbage cultivars on a farm in War. It was usually associated with irregular necrotic patches extending to the leaf margin. There are records of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) on Brussels sprouts (p. 81) and, earlier, on cauliflower. In 1962, cabbages in two gardens in Cards were affected, and in 1965 and 1967 respectively two cabbage crops in Hants succumbed, one of them severely. There were further odd records on Brussels sprouts and cauliflower curds.

Olpidium brassicae (Wor.) Dang. occurs, not uncommonly, in the roots of many plant species. It has been shown that it can be pathogenic to cabbages (Macfarlane, *Rep. Rothamsted exp. Stn, 1965*, 132-3). *Rhizopus stolonifera* (Fr.) Lind was associated with a soft rot of the foliage and curds of

cauliflowers in a crop in War in 1967. A species of *Pistillaria* (Clavariaceae) was present on the stalks of rotting Brussels sprout leaves in a crop in Cornwall in 1966.

Bacterial Leaf Spot (*Pseudomonas maculicola* (McCulloch) Stevens), which is known principally on cauliflowers, was diagnosed on cabbage in Ches in 1967. Symptoms similar to leaf spot are common on various brassicas but the organism can rarely be isolated from such material. There was a suggestion that other species of *Pseudomonas* might be involved in diseases of brassicas. A bacterium, tentatively identified as *Pseudomonas cichorii* (Swingle) Stapp appeared to be causing a leaf spot in a crop of Brussels sprouts in Beds in 1965. The spots had brown necrotic centres and occasionally, yellow haloes, and tended to be restricted by the veins. Some spotting developed on the outer leaves of the sprouts themselves. In December, 1968, *Pseudomonas viridiflava* (Burkh.) Clara was obtained from discrete, grey, sunken lesions on cv. Wheeler's Imperial spring cabbage in Worcs: two successive plantings were affected. In E. Kent, in the same year, an extensive necrotic spotting of collards, spring greens and other brassicas was found to be widespread and severe. Tiny, chlorotic, water-soaked spots were first seen in late September, on older leaves. With further spotting, and expansion and necrosis of the lesions, marketing ceased in mid-November and cutting was postponed until spring. *Ps. viridiflava* was often associated with the young chlorotic spots but complete proof of its pathogenicity could not be obtained.

The occurrence of an **Alga** (*Vaucheria* sp.) among cauliflowers on the soil of a cold-glasshouse border in the South-western Region prompted observations by N.A.A.S. on control. Captan and dichlorophen were both effective, giving an almost complete kill.

Cauliflower Mosaic was the only virus disease to be frequently reported.

A condition akin to **Oedema** (non-parasitic) appeared in Berks in 1962: discrete black streaks, often with split epidermis, were noted on cauliflower seedlings, sometimes running along the backs of the veins. In the Evesham Area in 1965 many brassica crops developed a lifting of the epidermis with splitting of the tissues attributed to **Low Temperature Injury.** A fine necrotic spotting of the cotyledons of a few cauliflower cultivars was observed at Efford E.H.S.: sometimes seedlings were considerably checked. At Kirton E.H.S. a similar necrotic spotting was found to be associated with **Manganese Toxicity.** In Worcs, in February 1968, some seedling cauliflowers under cold glass were scorched at the cotyledon stage. Most of the affected seedlings had twisted leaves which tended to stick together: the trouble was attributed to slow release of the herbicide propachlor under cold conditions.

Carrot

Alternaria Leaf Blight (*Alternaria porri* (Ell.) Ciferri f. *dauci* (Kühn) Neerg.) was first noted in this country in 1958 (see p. 84) when it appeared in several localities. No further field attacks were reported until 1968 when necrosed leaves were observed in crops in Kesteven (Lincs) towards the end of the year, following exceptionally wet conditions similar to those in 1958. However, although not noticed in the field during the intervening years it

could be found on seed samples (Hewett, *Agriculture, Lond*, 1964, **71**, 555-6; Maude, *Ann. appl. Biol.* 1966, **57**, 83-93). Hewett found that about 10 per cent of the carrot samples received at O.S.T.S., Cambridge were seriously infected with this fungus or with *Stemphylium radicinum* (Meier, Drechsl. & Eddy) Neerg. and another 10 per cent appreciably infected. Maude (*loc. cit.*) found the seed crop to be more liable to damage than the ware crop.

A record of **Licorice Rot** (*Centrospora acerina* (Hartig) Newhall) from Scotland was the first for Great Britain (p. 84). The first English records came in 1962 (Bant, *Pl. Path.* 1963, **12**, 136) when the disease was confirmed in carrots from a few fields in Lancs. In 1964 it was seen in a crop in Dur. Early in 1967 it was severe in overwintered crops in Notts and found in cold store and in an overwintered crop on wet land in Norfolk: later that year it was noted occasionally on a few farms in the Yorks and Lancs Region.

There has been no mention of *Fusarium* species in association with carrot rots in the past, but in 1963 a species of *Fusarium* was said to be affecting the roots and stem bases of a crop at Aberystwyth, and one was confirmed in a few carrots with crown rot in a sample sent for processing in Norfolk.

Pythium was mentioned in Part I (p. 86) as associated with 'cavity spot'. With *Fusarium* it was again associated with secondary rotting in roots affected with this trouble. During the 1962-68 period it was recorded once as rotting the crown and sides of roots in a Lancs crop. It is many years (1937; *see* Moore, *Br. Parasitic Fungi*, p. 332) since a record of **White Root Rot** (*Rosellinia necatrix* (Hartig) Prill.) on this host was received; in 1968, rotting of roots by the fungus was seen in the Scilly Isles.

An unusual record was that of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn), noted in Lincs in September 1967. A **Soft Rot** was associated with a species of *Pseudomonas* present in blackened areas on the sides of roots in a crop in Surrey early in 1966. In Yorks W.R. in 1964, **Dodder** (*Cuscuta* sp.) occurred in three fields, totalling 40 acres, sown with a single stock of seed. This parasitic plant was found every 50 yd or so along the rows, and clumps extended over three rows and up to 3 yd so that by August almost one quarter of one crop was covered with the yellow growth. However, a cool and wet September discouraged it and allowed the carrots to grow away after the check.

Motley Dwarf (carrot motley dwarf virus) was the most widespread virus. **Tomato Black Ring** virus was confirmed in a crop in Norfolk in 1967. The stand, and growth during the summer, was poor: roots were branched and fine roots were swollen, the foliage being dwarfed and older leaves yellow. The presence of the nematode *Longidorus* was confirmed in the soil.

'Cavity Spot', mentioned on p. 86 as causing considerable trouble in the east Midlands in 1960, occurred on many farms and was often widespread in the carrot-growing areas of the East Midland, Eastern, and Yorks and Lancs Regions during the last seven years. Numbers of consignments intended for processing or pre-packing had to be rejected. In 1965 it was particularly prevalent in the east Midland and eastern areas, becoming serious in the latter and the main disorder of this crop. The trouble occurred on a range of soils from sands in Norfolk, Suffolk and Northants, to black fens in East Anglia, heavy clay-containing silts in parts of the east Midlands and fertile mosses in Lancs. In 1966, the worst affected fields in Northants

were those where heavy rain fell in July and the light sandy soils were waterlogged for some time. There were other suggestions of an association with wet conditions. Chantenay types seemed more susceptible while cv. Autumn King showed resistance in a trial and in the field. Also affected were cvs. Clucas New Cored Stump and Danvers Red Cored. In Lancs it was noted that the symptoms were not very conspicuous at lifting as the pits were not usually more than 5 mm deep, the surrounding areas were not discoloured and the affected areas seemed to be callused off: however, after steam-cleaning the carrots became grossly discoloured and useless.

Another perplexing trouble, **'Five-o'clock Shadow'** (see p. 86), was fairly widespread in 1968. It usually appears during the steam-peeling process prior to canning. The cause is still unknown but the trouble originates in the field. The skinned roots show raised roughened areas which appear darker than the other tissue. A 'scurvy skin' condition, involving widespread russetting and scurviness, was reported from the Yorks and Lancs Region early in 1965 and was attributed to the particular dryness of the soil during growth of the crop.

Celeriac

Leaf Spot (*Septoria apiicola* Speg.) was seen during summer 1965 in Beds and Sussex: no prior report of the disease on this host has been traced for England and Wales. Also apparently new were the records of **Root Rot** (*Phoma apiicola* Kleb.) and **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary); the former was scattered throughout 3 acres of cv. Invictus in Surrey early in 1967 and affected 10 per cent of the plants, and the latter occasioned severe losses on a holding in Hants in the summer of 1965. About 10 per cent of a ½-acre crop in Surrey was affected with **Soft Rot** (*Pseudomonas* sp.) early in 1966.

Celery

Before these years, **Leaf Spot** (*Septoria apiicola* Speg.) became less in evidence as hot water treatment of the seed was more widely practised. From 1962-64 this satisfactory state of affairs continued but in the rather wet 1965 season leaf spot was much more prevalent all over the country than for several years, although severe attacks were mainly local. Seed was often reputed to have been hot water treated. In the Yorks and Lancs Region cvs. Lathom Blanching and Golden Marvel were most involved and infection was not seen in maincrop celery. In the east Midlands, losses occurred mainly in crops from one seed source. Very much less was seen in 1966 and again in 1967 but crops in the Norfolk fens were extensively affected in 1966 and the position worsened in November. In the Newent area of Glos leaf spot was widespread and severe in self-blanching and green celery in both 1966 and 1967, in spite of hot water treatment. The Eastern Region had more infection and greater severity than usual in 1968 and leaf spot was quite severe in the East Midland Region following rapid spread in humid weather in autumn. In the latter Region, spread seemed to be from a few stocks said to have been treated by hot water or thiram soak.

Centrospora Rot (*Centrospora acerina* (Hartig) Newhall) was first reported in celery in England (Beds) in 1952 (Storey and Wilcox, *Pl. Path.* 1953, **2**, 72): it affected roots and petioles in the field. It has also been found in stored celery from Cambs and Lincs (Lowings, ibid. 1955, **4**, 106-7). No further reports were received until 1963. From 1963-68 several reports from the east, east Midlands and Glos were received of symptoms seen in the field or store. Roots, crowns and petioles bases were variously rotted. Affected crops in the east Midlands in 1967 and 1968 were those tending to become overmature. Seven crops were affected in the Newent area of Glos in 1967.

A disease known in U.S.A., **Brown-spot** (*Cephalosporium apii* M.A. Smith & Ramsey), was first noted in England in 1962 and 1963 on a nursery in Wilts (Sheridan, *Pl. Path.* 1964, **13**, 161-3). In 1967 it was found on a small proportion of plants in a crop of cv. Lathom Blanching in Lancs.

Fusarium species had not been reported in association with disorders of celery in this country, though they had been elsewhere. In 1965, *Fusarium oxysporum* Fr. was isolated from stained vascular tissue, from roots though not stems, from stunted yellowed plants in a crop of self-blanching celery in Glos. It was the third successive celery crop, and the level of infestation by *Pratylenchus* in the soil around the crop was greater in the third than in the first year healthy crop. It seemed likely that the stunting and yellowing were primarily caused by the eelworm and that the *Fusarium* was of secondary significance only. *Phytophthora* species are also not very familiar on this host, though *P. cryptogea* was isolated when frequent damping-off in seedlings occurred in Lincs and Yorks in 1920-21 (*Misc. Publ. Minist. Agric., Lond.* No. 38, 1922, p. 50). A species of *Phytophthora* was noted in rotted roots of plants growing poorly in Cornwall in autumn 1965 and another attack occurred in Worcs in spring 1968. *Pythium* spp. occasionally caused damping-off or root rot in celery. A species of this genus which was affecting seedlings in trays in Leics and Derbys in April 1967 was thought possibly to be *P. megalacanthum* de Bary: the roots contained numerous echinulate oospores. This fungus has previously been recorded on watercress and chrysanthemum (Moore, *Br. Parasitic Fungi*, p. 318). *Artotrogus hydnosporus* Mont. (syn. *Pythium artotrogus* de Bary) causes 'rusty root'. *Stemphylium radicinum* (Meier, Drechsl. & Eddy) Neerg. was found causing a seedling disease in Cambs in 1945 (Moore, *Trans. Br. mycol. Soc.* 1945, **28**, 131-2). Another report of the fungus causing damping-off in celery came from Beds early in 1965.

Rust (*Puccinia apii* Desm.) has not been recorded for 80 years or so.

A purplish-pink rot of the bases of petioles, in War in 1968, was attributed to **Soft Rot** (*Pseudomonas marginalis* (Brown) Stevens).

Several viruses are known to occur in celery (see also p. 88). **Cucumber Mosaic** and **Alfalfa Mosaic** viruses are prevalent (Hollings, *J. hort. Sci.* 1964, **39**, 130-41). **Arabis Mosaic** virus has several times been isolated from stunted plants with chlorotic leaves. It was recorded in 1962 and 1963 from Glos; in 1964 from Norfolk (Walkey, *Rep. natn. Veg. Res. Stn, 1965*, 75), and in 1967 from Ches. It was found with other viruses in plants of cv. Lathom Blanching from East Anglia which showed a **'Strap-leaf'** condition, but only **Strawberry Latent Ring Spot** virus (SLRV) of those viruses induced this disorder in experiments (Walkey and Mitchell, *Pl. Path.* 1969, **18**, 167-72). Strap-leaf had appeared on Fenland farms in East Anglia in autum 1966

and, to a lesser extent, in 1967 and 1968. Strap-leaf symptoms have also been recorded from Lancs since 1965.

Celery **Yellow Net** virus (Hollings, *Rep. Glasshouse Crops Res. Inst. 1959*, 73-4) was reported from Surrey in 1967 and (Hollings, *J. hort. Sci.* 1964, **39**, 130-41) has been seen occasionally in Suffolk and the west Midlands. According to Hollings (ibid.) a virus tentatively identified as celery **Yellow Spot,** known in U.S.A. occurs commonly in English celery crops. Celery **Ring Spot** virus has been found occasionally (Hollings, ibid.), and the celery **Yellow Vein** virus, found on a group of Suffolk holdings during 1957-59 in cv. Golden Marvel Blanching has been shown by Hollings to be serologically related to tomato black ring virus (*Ann. appl. Biol.* 1965, **55**, 459-70). Another virus frequently found in celery, also in parsley and coriander in Britain (Walkey and Mitchell, *Pl. Path.* 1969, **18**, 167-72 (pp. 169-70)) has now been identified as **Western Celery Mosaic** (Walkey, Tomlinson and Frowd, *Plant Dis. Reptr*, 1970, **54**, 370-1).

Non-parasitic troubles mentioned in reports for this period, though not referred to in Part I were **Bolting** associated with early sowings and cold weather in early stages of growth, **Strangles** associated with continuous winds on dry soils, and a **Heart Rot** which was prevalent in the Methwold area of Norfolk before rains in 1964 but after rain was found infrequently.

Coriander

Diseases of coriander have received little attention in the past but have been under study at N.V.R.S., Wellesbourne in recent years. Taylor (*Rep. natn. Veg. Res. Stn, 1967*, 82) isolated two species of *Pseudomonas* from plants with necrosed stem tips and leaves as well as with symptoms associated with virus infection (see below). The bacteria induced similar symptoms when inoculated into young plants. Investigations started in July 1966 after virus was suspected in seed crops grown in Essex (Tomlinson and Webb, ibid. *1966*, 71). From June to August 1967 several crops in Hants, Essex and Wilts were surveyed for virus symptoms: similar leaf yellowing, distortion, flecking, reddening and premature death of plants were found on most sites and several viruses were isolated (Webb, ibid. *1967*, 79). A disease characterized by conspicuous yellowing of the leaves and a severe stunting of plants was found to be caused by two viruses (Tomlinson, ibid. *1968*, 88-9). A virus frequently occurring in coriander, celery and parsley in Britain, and under study from 1966 has recently been identified as **Western Celery Mosaic** virus (Walkey, Tomlinson and Frowd, *Pl. Dis. Reptr*, 1970, **54**, 370-1).

Cucumber

The disease picture has been affected by newer cultural methods and cultivars, and by general conditions.

From 1965 to 1967 inclusive, **Grey Mould** (*Botrytis cinerea* Fr.) was a serious problem in the Lee Valley. The season was the worst for some time: the fungus was particularly troublesome early in the season and some crops had to be pulled out by June because of stem infections. In 1966 it was very

severe by July, while in 1967 the first severe attacks had occurred by May and many first crops were killed off. Grey mould had become the most important fungus disease of the crop in the area. **Gummosis** (*Cladosporium cucumerinum* Ell. & Arth.) was not much in evidence: most of the more recently introduced hybrid cultivars, now quite widely grown, are resistant to the disease.

In 1964, **Powdery Mildew** (*Sphaerotheca fuliginea* (Fr.) Poll.) was notably absent from the Lee Valley. In contrast, 1966 brought early attacks and build-up to serious levels: incidence was generally higher than for some time, while attacks in 1967 were even worse, becoming epidemic on many nurseries by mid-July. A tendency to later planting and later cropping in autumn, with in some cases overlapping of propagation with the previous crop, may have affected the status of the disease. Other possible factors included a reduction in the use of white-oil sprays for control of red spider mite. In spite of more extensive early attacks than usual in 1968, helped by a current trend towards centralized propagation, the use of systemic fungicide kept the disease at a low level. Stone (*Ann. appl. Biol.* 1962, **50**, 203-10) has examined the host range of the fungus.

The first records of **Fusarium Wilt** (*Fusarium oxysporum* Fr.) were made by Fletcher and Kingham (*Pl. Path.* 1966, **15**, 85-9). The disease was first noted in the Lee Valley in 1962, and by 1968 infection had been found on 10 nurseries. The results of pathogenicity experiments (*loc. cit.*) were similar to those obtained in the U.S.A. with *F. oxysporum* Fr. f. *cucumerinum* Owen. Other attacks of this wilt were noted in Kent and Anglesey.

Stem Rot (*Mycosphaerella melonis* (Passer.) Chiu & Walk.) reached epidemic proportions on a number of nurseries in the Lee Valley in 1962. In 1963, Fletcher and Preece (*Ann. appl. Biol.* 1966, **58**, 423-30) found this disease in cv. Butcher's Disease Resister in every glasshouse they surveyed in the Valley (two cucumber crops in each of 49 nurseries) but found no correlation between severity and any of the cultural practices etc. they considered. In late autumn 1967 many 'pointed' fruits on one nursery were discoloured brown internally and *M. melonis* was consistently isolated from the discoloured tissues. This symptom had rarely been seen. Brown and Preece (*Pl. Path.* 1968, **17**, 116-8) examined methods of cucumber seed production in the Lee Valley and found no evidence that the fungus was seed-borne. However, Brown, Howard and Knight (*Pl. Path.* 1970, **19**, 198) have since established that it can be transmitted with seed.

Damping-off and Foot Rot (*Pythium* sp.) were frequent problems, and **Verticillium Wilt** (*Verticillium* spp.) was sometimes troublesome.

Failures during propagation have been familiar in earlier years and attributed to various non-parasitic causes. The association of *Olpidium* with loss of plants during propagation was mentioned on p. 90 . In 1962, only *Olpidium* sp. was found in the roots of affected plants on 10 nurseries where failures had occurred at the seedling stage or between potting up and planting out. Tap roots were decayed and laterals browned, and very numerous *Olpidium* spores were often present. Five to 20 per cent losses were quite common. Similar specimens from 11 nurseries in the Lee Valley were examined in the first few months of 1964: the root systems of plants from five of the nurseries were tested for virus, and tobacco necrosis virus was found in one case only. Other records of similar trouble came from a Devon nursery in 1963 and the

odd nursery in other years. The 1966 season was noteworthy for the amount of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) in the Lee Valley.

A **Root Rot** of cucumbers, involving a microsclerotial fungus was investigated at G.C.R.I., Rustington (Ebben and Last, *Rep. Glasshouse Crops Research Inst. 1966*, 86-8; *1967*, 85-6). This disease was also being studied in Holland and there the fungus was identified as *Phomopsis sclerotioides* van Kesteren (*Neth. J. Pl. Path.* 1967, **73**, 112-6). The trouble appeared to be widespread in the Lee Valley and the south-east and has been noted in Yorks, Norfolk, Worcs and Dorset. In the Lee Valley it was considered to be a major cause of root rot and by 1968 had been confirmed on many nurseries. Observations on the disease were made by Wiggell and Simpson (*Pl. Path.* 1969, **17**, 71-7) in Worcs.

Two uncommon fungi caused **Leaf Spot.** In 1967, *Phyllosticta cucurbitacearum* Sacc. was noted on a nursery in Som. It had previously been seen only in the Lee Valley (1926, 1935, see Moore, *Br. Parasitic Fungi*, p. 225). *Alternaria cucumerina* (Ell. & Everh.) Elliott which had attracted no attention for very many years caused widespread infection in several houses in bed-grown cv. Butcher's Disease Resister in the South-western Region. In one house it was particularly severe, affecting the lower leaves most badly. The grower was said to have obtained some control by trimming off the affected leaves and increasing ventilation. **Root Rot** (*Pythium aphanidermatum* (Edson) Fitzp.) was confirmed in Herts in 1964 and in Cambs in 1968. The fungus had been recorded causing a stem rot in 1942 (Hickman, *Trans. Br. mycol. Soc.* 1944, **27**, 63-7). The fungus *Ascophanus carneus* (Pers.) Bond is familiar on straw bales in cucumber houses, normally appearing within a few weeks of planting. Although not a pathogen, a prolific growth of it is often associated with symptoms of nitrogen deficiency. In 1968 there seemed to be much more of this fungus in the Lee Valley than usual. The myxomycete *Fuligo septica* Gmel. was found colonizing plants on four nurseries.

Green Mottle (cucumber green mottle mosaic virus) (Plate II) had been noted in the Lee Valley on three, four, ten and four nurseries respectively from 1960-63, but at the end of 1964 the majority of crops there showed symptoms (Fletcher, George and Green, *Pl. Path.* 1969, **18**, 16-22) and it was regarded as the worst year ever. All attacks were associated with a single seed source. In 1964 the virus was confirmed for the first time in the South-western Region when extensive infection was found on one nursery. In the Lee Valley in 1965 symptoms were absent in the early-planted crops, but present in many of the second crops, while in 1966 only one case was reported —the lowest level for some years: in 1967 and 1968 only three nurseries were affected in each year. Several nurseries in Yorks had mild attacks in 1966 and 1967, though a few severe attacks also occurred in the latter year. One or two records came from Sussex.

The spinach strain of **Cucumber Mosaic** virus was associated with unusual symptoms on three Lee Valley nurseries in summer 1965. Yellow banding along the veins of some older leaves was sometimes limited to half a leaf. Pronounced yellow ring spots occurred on the younger growth. Only second-year crops were affected and little spread occurred. A virus resembling **Lucerne Mosaic** (alfalfa mosaic virus) was isolated from plants on two nurseries in the Lee Valley in 1965. **Tobacco Necrosis** virus (TNV) has

been isolated from cucumber plants on a few occasions in the Lee Valley. In 1967, raised yellow blotches occurred on the many fruits in two houses on a Yorks E.R. nursery. Although foliage symptoms were characteristic of cucumber mosaic virus, and this was confirmed in the leaves, no CMV could be detected in the fruit. However, TNV was isolated from these fruits and confirmed in bait plants grown in soil from the same house.

A severe necrosis of older leaves on four nurseries in the Lee Valley in 1967 was attributed to faulty lamps emitting a harmful level of U-V light.

Oedema was noted on one occasion. The failure of one cotyledon to develop was a consistent feature of erratic germination of cv. Sporu on a number of Lee Valley holdings in 1968. Severe malformations occurred on some holdings in the South-eastern Region from the use of straw, in bales or incorporated into borders, from cereal crops treated with herbicide containing TBA. Similar damage from the same cause was noted in N. Wales. In 1962 **Ammonium Scorch** was severe on a few nurseries where plants were grown on straw bales in the Lee Valley; and severity seemed to be connected with the use of an activator.

In spring 1968 several crops in the Lee Valley were characteristically distorted. Plants had apparently formed two or three nodes together so that the head was bunched. Laterals had grown prolifically within the bunched area and petioles were often fasciated and the leaves lobed or deeply divided. Water stress was thought to be involved, the growing tip being damaged but without the more usual tip necrosis.

Horseradish

There were no records of **Pale Spot** (*Ramularia armoraciae* Fuckel) during 1957-61, though it is reputedly fairly common (Moore, *Br. Parasitic Fungi*, p. 322; Dring, *Trans. Br. mycol. Soc.* 1961, **44**, 333-6). By autumn, in 1967, it was sufficiently damaging to the foliage in a crop in War to be thought to have affected root yield. In 1968 it was again damaging in a crop in War; the infection, first seen in July, spreading rapidly. **White Blister** (*Albugo candida* (Hook.) O. Kuntze) was heavy in autumn 1962 on a few plants on a holding in Ches.

An outbreak of a **Leaf Spot** (*Pseudomonas syringae* van Hall) was of interest. The bacterium was readily isolated from spots on leaves from a crop in War in 1968: the spots, which had yellow haloes, remained small, round and discrete. Various bacteria have been associated with **Root Rot**. *Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye and *Pseudomonas marginalis* (Brown) Stevens were isolated from a rotting root from Norfolk in summer 1968, the latter bacterium also being isolated from the petiole. *Ps. marginalis*, *Erwinia carotovora* (Jones) Bergey *et al.* var. *atroseptica* (van Hall) Dye and *Flavobacterium pectinovorum* were isolated from roots in the Eastern Region late in 1968. *Ps. marginalis* was regularly isolated from superficial rotted areas of roots undergoing routine examination in the Eastern Region in 1968. In one instance this bacterium was isolated from badly rotted roots of plants which bore a tuft of young leaves 6 in. tall in comparison with healthy plants which were only 1½ in. tall.

Arabis Mosaic, Cabbage Black Ring Spot (strain of turnip mosaic

virus) and **Cauliflower Mosaic** viruses have now been detected in horseradish crops in this country (Hickman and Varma, *Pl. Path.* 1968, **17**, 26-30).

Leek

Rust (*Puccinia allii* Rud.) and **White Tip** (*Phytophthora porri* Foister) were the main leek diseases.

Damping-off fungi were of interest: *Phytophthora* sp. and *Pythium* sp. were independently recorded in the Evesham Area in 1966 and *Botrytis cinerea* Fr. in Northumb in 1968. *Phytophthora* and *Botrytis* have not previously been recorded in this connection and *Pythium* only once (p. 92). **Soft Rot** (bacterial) was mentioned in reports. Leeks with symptoms similar to those caused by **Onion Yellow Dwarf** virus were seen in Newcastle in 1963 and in Pemb in 1966. Calvert and Harrison (*Hort. Res.* 1963, **2**, 115-20) identified **Tomato Black Ring** virus in diseased plants in Northern Ireland: the isolate was indistinguishable from the beet ring spot form. **Bulbing** (non-parasitic) affected 40 per cent of about 80,000 plants of cv. Yates Empire in a seed bed in Worcs in 1962: drought was a likely cause, a similar condition having apparently occurred in the Vale of Evesham in 1947.

Lettuce

Grey Mould (*Botrytis cinerea* Fr.) and **Downy Mildew** (*Bremia lactucae* Regel) remained the major fungus diseases, while **Ring Spot** (*Marssonina panattoniana* (Berl.) Magn.) was prominent in some years. Three races (W1, W2, W3) of downy mildew have now been distinguished in this country (Channon, Webb and Watts, *Ann. appl. Biol.* 1956, **56**, 389-97; *Rep. natn. Veg. Res. Stn, 1966*, 67); a further isolate appeared to differ from any of these three (Channon and Smith, ibid. *1967*, 82).

Although no reports of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) were received during the 1957-61 period, this fungus has not been at all uncommon in the past. There were more than a dozen outbreaks in the 1962-8 period and some were extensive and severe. Species of *Phoma* and *Verticillium* have not previously been associated with lettuce disease in this country, but, in 1965, *Phoma* was isolated from young plants with rotting stems on a holding in Glos, and *Verticillium* from roots of plants from two nurseries in N. Wales. Both the latter nurseries had had a history of trouble with *Verticillium* in tomatoes; however, the particular plants in 1965 also had a basal rot associated with *Botrytis*. *Verticillium* was re-isolated from plants grown in artificially contaminated compost but appeared to have no effect on growth of plants.

Moore (*Trans. Br. mycol. Soc.* 1940, **24**, 346-9) recorded **Leaf Spot** (*Septoria lactucae* Passer.) in 1940 but the fungus had not been seen since. In August 1966, 60 per cent of young plants of cv. Summer King on a nursery in the Evesham Area had necrosed cotyledons. Pycnidia of the fungus were seen on dying tissues: thiram sprays prevented further spread to developing leaves. The seed had been imported from the Netherlands.

The occurrence of two non-parasitic fungi was of interest. *Phycomyces blakesleeanus* Burgeef grew in a box of lettuce seedlings in the Eastern Region:

it was thought, perhaps, to be competing for water with the lettuces and to be allowing infection of nearby seedlings with *Botrytis cinerea*. The dung saprophyte, *Pilobolus sphaerosporus* (Grove) Palla, the ejected sporangia of which occasionally disfigure crop plants, reduced the quality of a crop in Yorks W.R. in 1966 as over half the lettuces carried the adhering black bodies.

A few outbreaks of the **Bacterial Wilt** (*Pseudomonas* sp.) recorded earlier (see p. 94) were seen in 1962 and 1963. In 1966 most plants of cv. Southdown B on a Glos nursery had a dark-brown, firm, water-soaked 'collar rot' with which *Pseudomonas marginalis* (Brown) Stev., the causal agent of marginal leaf spot, was associated.

In 1963, the petioles of the outer leaves of many plants of cv. Attractie, in a Dutch light structure in War, were discoloured a bronze-brown: not always the oldest leaves or those in contact with soil were affected. A bacterium, resembling *Pseudomonas cichorii* (Swingle) Stapp, was isolated by the Bacteriology Department of the N.A.A.S. at Wolverhampton, and produced similar symptoms on reinoculation to lettuce.

In 1968, **Cucumber Mosaic** (CMV) and **Lettuce Mosaic** (LMV) viruses were at their highest level for at least eight years, in commercial and garden lettuces in the West Midland Region. Aphid populations in the summer were high and resulted in epidemic spread of the viruses. Similar high levels and serious losses were reported in other Regions. The Plant Pathology Department in the west Midlands collected a series of weeds from sites in Salop where lettuce crops had failed due to CMV. This virus was transmitted to test plants from *Capsella bursa-pastoris*, *Cerastium arvense*, *Lamium purpureum*, *Senecio vulgaris*, *Sonchus arvensis* and *Urtica dioica*. LMV also was transmitted from *Senecio vulgaris*. Tomlinson and Carter (*Rep. natn. Veg. Res. Stn, 1968*, 87) started work in 1968 on a yellowing disease which had caused heavy losses in outdoor crops in various parts of the country. The outer leaves of stunted plants were yellowed, necrotic flecks sometimes occurred on the inner leaves, and plants failed to heart. The presence of CMV, sometimes with LMV, was demonstrated.

Big Vein (lettuce big vein virus) was the other prevalent virus disease. **Arabis Mosaic** virus (AMV) was earlier recorded in plants from Pembroke (p. 95). Between 1962 and 1966, the virus was confirmed at several places in Glos and the Evesham Area. In one outbreak in Glos in which this virus and strawberry latent ring spot were confirmed by Dr. B. D. Harrison, there were severe mosaic-like symptoms with a leaden appearance, and severe necrotic spotting especially in the first whorl of leaves. The crop had been sown in July and the symptoms were noted in August. A severe disease involving chlorosis, necrosis, stunting and failure to heart, was found in 1965 on a fenland farm in Norfolk: Walkey (*Pl. Path.* 1967, **16**, 20-2) called it **Chlorotic Stunt** and showed it to be caused by a strain of AMV. He also showed it to be seed transmitted in several cultivars (*Plant Dis. Reptr*, 1967, **51**, 883-4; *Rep. natn. Veg. Res. Stn, 1967*, 78) The **Lettuce Ring Spot** strain of tomato black ring virus was identified by Hollings and Stone (*Rep. Glasshouse Crops Res. Inst. 1963*, 88-9) in plants raised from commercial seed, and circumstantial evidence suggested that the virus was present in the seed. **Tobacco Rattle** virus was identified in glasshouse lettuces from a Glos nursery where symptoms had been seen in February 1966 and March 1967.

In 1966 intermediate and heart leaves were said to be slow to grow, and were pinched and distorted with a network of necrotic furrows on the surface. Later these leaves developed pinhead-sized depressions on the lower surface corresponding with raised areas on the upper surface. About 5 per cent of the crop failed to heart. Slow growth and failure to heart were features of the crops in three houses in 1967. Tobacco rattle virus was identified by sap inoculation techniques and electron microscopy. The eelworm vector, *Trichodorus* was identified in soil from the seed bed.

Various disorders associated with water relations were reported. An unusual condition was noted in Yorks E.R. in November 1963 in cv. Amplus, and in November 1964 in cvs. Kwiek and Kloek in Yorks E.R. and in a breeding line in Yorks W.R. The main feature was the oily look of the margins of the wrapper, and next-outermost, leaves, These margins were more or less transparent, though the chlorophyll seemed unaffected. Occasionally, isolated water-soaked areas occurred away from the margins. Affected tissues were waterlogged, while in the worst affected plants leaf margins appeared scorched. All plants had grown rapidly and strongly. Very high humidities, perhaps involving water uptake through the leaf surface, were coupled with warm soils in which roots would still be actively taking up water. Affected plants placed on a laboratory window-sill, near the updraught from a radiator, lost water from the translucent water-soaked tissues, which filled once more with air. A similar oily appearance to the leaf margins was seen in several glasshouse lettuce crops in Devon in 1966.

Early in 1968, elongated brown areas appeared on the undersurfaces of the petioles of the outer leaves of a crop of cv. Noran in Yorks E.R. The trouble was believed to be of non-parasitic origin and resembled **Brown Veins,** recorded in the Netherlands (Baelde and Groenewegen, *Hort. Abstr.* 1967, **37**, No. 5006) and believed due to withdrawal of water from the affected parts. In Dutch trials, alternating wet and dry conditions were believed to be related, and cv. Noran was very susceptible to the condition.

Symptoms, noticeable on occasions in several areas and associated with **Frost Injury,** were detachment of the lower epidermis to give a silvery appearance, accompanied by splitting to expose the mesophyll which had dried up and turned brown. Various forms of leaf distortion were associated with frost injury. Widespread complaints from the South-eastern Region in 1968 of yellow unmarketable lettuces were attributed largely to **Magnesium Deficiency.**

Mint

Nine physiologic races of **Rust** (*Puccinia menthae* Pers.) from sources in England have been distinguished (Fletcher, *Trans. Br. mycol. Soc.* 1963, **46**, 345-54). **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted in the present author's garden in 1964: it had previously been recorded in mint in Cumb in 1953. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was severe on a holding in Hants in August 1965: this fungus and also *Pythium* and *Rhizoctonia*, seen in 1968, were believed to be newly recorded on this host. The *Pythium* (unidentified species) was isolated from blackened rhizomes collected from a 2-acre crop in Surrey containing large areas of

dying plants: the soil was very wet. The *Rhizoctonia* sp. was associated with death of roots in a crop in Glam, again from very wet soil.

Dennis and Gilbert (*Kew Bull.* 1963, **16**, 391) recently recorded *Physoderma menthae* Schroet. in pustules at the stem base of herbarium material collected in 1900 at Wisley, Surrey. The disease had not previously been found in Britain.

Cucumber Mosaic virus was isolated from plants showing a bright yellow-green mottle on two nurseries in Glos in 1965, and the virus was reported in 1966 in Glos and the Evesham Area.

Mustard

Pods and shoot tips of a Trowse mustard crop in Norfolk in August 1967 were completely distorted. Associated with the condition was **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.), but the extent of hypertrophy suggested an initial attack by white blister.

A disease of mustard in which leaves bear many small round black lesions, and stems bear long streak-like lesions, has been attributed to *Pseudomonas maculicola* (McCulloch) Stevens (Taylor, *Rep. natn. Veg. Res. Stn, 1967*, 82; *1968*, 96).

Onion

White Rot (*Sclerotium cepivorum* Berk.) was particularly general and severe in the Vale of Evesham in autumn 1962. Its importance in the Vale as a cause of losses in pulling onions seemed to be on the increase as new and uncontaminated sites for the crop were becoming more difficult to find. Another season when it was particularly widespread in this area was 1965, and the disease was of greater concern as the pure calomel seed treatment was no longer considered economic. The other main diseases of onion were **Neck Rot** and **Leaf Rot** (*Botrytis* spp.) and **Downy Mildew** (*Peronospora destructor* (Berk.) Casp.).

A **Bulb Rot** attributed to *Penicillium* sp. was noted in Worcs early in 1965 in cv. Stuttgart Giant.

The identification of **Tomato Black Ring** virus, indistinguishable from the beet ring spot form, in onion crops in Northern Ireland was recorded by Calvert and Harrison (*Hort. Res.* 1963, **2**, 115-20).

Parsley

A severe attack of **Leaf Blotch** (*Stemphylium radicinum* (Meier, Drechsl. & Eddy.) Neerg.), in a crop grown for seed in Suffolk in 1967 and 1968, was believed to constitute a new host record for this country. Various fungi are associated with problems of establishment or dying-back of parsley plants. *Pythium* sp. and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. are among them; neither seems previously to have been mentioned on this host, but in these years several outbreaks of **Damping-off** or **Root Rot** were attributed to them. In one instance of damping-off, in a crop irrigated from overhead, *Phytophthora* sp. and *Centrospora* sp., in addition to *Pythium*, were detected. A species of *Phytophthora* was isolated

1. Natural infection of lucerne plants by bacterial wilt (*Corynebacterium insidiosum*) (p. 228). Three plants are stunted, two extremely so, and show chlorosis and a near witches' broom condition (matchbox indicates reduced size). There is no true wilt.

2. Lucerne plant affected with *Verticillium alboatrum* (pp. 68, 227), in a plot. Leaves are chlorotic and growth is stunted.

PLATE XIII

Leaves and pods of tic bean affected by *Ascochyta fabae* (pp. 58, 223).

PLATE XIV

from rotted crowns of small plants from a ¾-acre crop in Surrey, a quarter of which was affected in May 1967. No other records of *Phytophthora* on this host have been found for this country. In summer 1967, circular patches, in which plants were severely stunted and had died back, were noted in several crops in the Evesham Area: *Pythium periplocum* Drechsl. was consistently isolated from the roots, which showed reddish-brown areas. In the Wirral area of Ches, where failure of early sowings to establish has been a problem, *Pythium*, *Rhizoctonia* and *Centrospora acerina* (Hartig) Newhall have all been found in affected seedlings. Here, damage from herbicide residues, and acid soil conditions, have been possible factors too.

In 1962, **Cucumber Mosaic** virus was isolated from plants in a crop in Surrey: 80 per cent of 2½ acres showed the symptoms. **Carrot Motley Dwarf** (virus) was suspected in Bucks in 1962, and in two crops in the south-east in later years. Serious loss of yield in crops in Beds and in the south-west was associated with what appeared to be carrot motley dwarf virus (Froud and Tomlinson, *Rep. natn. Veg. Res. Stn, 1968*, 88). Also occurring in parsley. as well as in celery and coriander, is a virus now identified as **Western Celery Mosaic** virus (Walkey, Tomlinson and Froud, *Pl. Dis. Reptr*, 1970, **54**, 370-1).

Parsnip

Channon has distinguished between two main types of **Canker** (*Ann. appl. Biol.* 1963, **51**, 1-15). The, more common, black form is caused by *Itersonilia* or by *Phoma* or by both, and also (Channon, ibid. 1965, **56**, 119-28; *Pl. Path.* 1963, **12**, 136) by *Centrospora acerina* (Hartig) Newhall. He found the latter fungus in parsnips growing in the E. Anglian fens and it has also been noted in Dur. Channon regarded most of his *Itersonilia* isolates as belonging to a new species which he called *Itersonilia pastinacae* and the remainder as resembling *I. perplexans* Derx. The cause of the second, orange-brown, type was unknown. *I. pastinacae* has been found in seed crops and also in seed in this country (Channon, *Pl. Path.* 1967, **16**, 192). This same worker obtained evidence that isolates of *Cephalosporium*, present in parsnips from various localities, were pathogenic but concluded that *Cephalosporium* is not a major cause of canker though it may sometimes be involved in the rotting of parsnip roots (*Rep. natn. Veg. Res. Stn, 1964*, 68; *1966*, 66).

Leaf Spot (*Ramularia pastinacae* Bubák) is mentioned infrequently in reports. The sole record in this period came from Sussex in 1966. Several apparently undescribed viruses have been obtained from parsnips and have been studied in England (N.V.R.S.) and in Scotland (S.H.R.I.). Among these were parsnip **Mosaic** virus, which occurs commonly according to workers in Scotland (Murant and Munthe, *Rep. Scott. hort. Res. Inst. 1966*, 64), and parsnip **Yellow Fleck** (Murant and Goold, ibid. *1966*, 64).

Pepper

Grey Mould (*Botrytis cinerea* Fr.) severely affected a few fruits at N.A.A.S. Regional H.Q. Reading in 1962. The trouble started at the stem end.

Fletcher has described the symptoms caused by **Tobacco Mosaic** virus (see p. 98) in sweet peppers (*Pl. Path.* 1963, **12**, 113-4).

Radish

In spring 1968, nearly all the bulbs in several glasshouses on a nursery in the Lee Valley were blackened and their outer tissues cracked. *Alternaria brassicicola* (Schw.) Wiltsh. was isolated from these bulbs and also from leaf spots which developed after incubation of the leaves though few or no leaf symptoms were seen in the crop. The fungus was also found on samples of the seed. **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) is an occasional parasite of radish (p. 98), and is found on both leaves and bulbs. In an outbreak in Surrey in 1968, it occurred throughout an $\frac{1}{8}$-acre crop, but was found only on the bulbs, on which conidia were freely being produced. The first published account of the fungus on the bulbs would appear to be that of Ramsey, Smith and Wright (*Phytopathology*, 1954, **44**, 385). A **Leaf Spot** (*Pseudomonas* sp.) was noted in 1964 in a 10-acre crop of fodder radish, which had received heavy applications of nitrogen, in Cards. The soft, wet, black spots also occurred on the stems.

Rhubarb

Grey Mould (*Botrytis cinerea* Fr.) was noted in the odd forced crop, and the fungus was found in one crop to be causing a spotting of stalks. There were two reports of **Leaf Spot** (*Ramularia rhei* Allesch.), from Sussex and Essex respectively. *Pseudomonas marginalis* (Brown) Stevens, recorded in Scotland in 1960 (p. 99), was isolated from pre-packed rhubarb from the Yorks and Lancs Region in summer 1966: this was the first confirmation of the trouble from England. Virus-like symptoms are common in rhubarb; Tomlinson and Walkey (*Ann. appl. Biol.* 1967, **59**, 415-27) have confirmed the following viruses:- **Turnip Mosaic,** severe and mild isolates of **Arabis Mosaic, Cherry Leaf Roll, Cucumber Mosaic** and **Strawberry Latent Ring Spot** viruses. Virus-free rhubarb has been produced by apical meristem culture (Walkey, *J. hort. Sci.* 1968, **43**, 283-7).

Rosemary

In 1964 **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was recorded in Sussex—apparently a new host record for this country.

Sage

Growers in the Evesham Area have been familiar with a die-back problem for many years. The acreage of sage in the area had expanded in the 1960's, and this widespread trouble was causing concern. The major disease involved was shown to be **Verticillium Wilt** (*Verticillium dahliae* Kleb.) (Ryan, *Ann. appl. Biol.* 1966, **58**, 71-9). Two earlier records of this fungus on sage came from Surrey (p. 99). However, in 1967, *V. dahliae* could not be isolated from a strain of sage showing die-back symptoms identical to those shown by other strains: it was thought that cultural and management factors may also be involved in the die-back phenomenon.

The **Powdery Mildew** (*Oidium* sp.) recorded in Worcs in 1955-6 (Moore,

Br. Parasitic Fungi, p. 222) was noted again in the Evesham area in 1962-4, being above average in the latter year and prompted many growers to apply dinocap. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was identified in a crop near an old hedge in the Evesham area in 1965.

Seakale

There was another report of **Black Rot** (*Xanthomonas campestris* (Pammel) Dowson) (see. p. 99) in 1963—this time from Worcs. A marked banding of the veins, suggestive of **Cauliflower Mosaic** virus was apparent in a number of strains being grown in a garden plot in Worcs in 1963: infection with both this virus and **Cucumber Mosaic** virus was confirmed.

Shallot

Downy Mildew (*Peronospora destructor* (Berk.) Casp.) drew no comment during 1957-61. In 1966 it was commonly seen in several Welsh counties, and odd records from Wales were received in most other years. **Bulb Rot** (*Penicillium* sp.) was observed in the Evesham Area in summer 1965. **Yellows** (onion yellow dwarf virus) was seen on several occasions in mid-Wales in 1962, though the incidence was generally low. Preliminary results at G.C.R.I. suggested that shallot yellows virus may be distinct from onion yellow dwarf virus (Hollings, *Rep. Glasshouse Crops Res. Inst. 1967*, 108).

Spinach

Damping-off or similar troubles of spinach have not previously been associated with *Rhizoctonia* .In 1962, a crop in Lancs failed to establish, failure being less severe in the heavier parts of the field; the seedling blight was attributed to *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. Another instance was reported from Surrey in 1968; *Rhizoctonia* was isolated from damped-off seedlings. Root rot caused by a species of *Pythium* was mentioned on p. 100; during these later years the fungus was recorded as responsible for damping-off in one instance in Holland (Lincs) and for black leg in another in Bucks. Several crops on a Bucks farm were affected by **Root Rot** (*Phytophthora cryptogea* Pethybr. & Laff.) in May 1968, when water was not draining away (see also p. 99).

Colletotrichum spinaciae Ell. & Halst. which was identified by the present author on prickly spinach seed harvested in England in 1953, and probably seen in 1937 by W. C. Moore (Baker, *Pl. Path.* 1954, **3**, 139) has not since been found in the field in this country nor on English-grown seed examined at Plant Pathology Laboratory, Harpenden.

Tomato

Of the most commonly encountered fungus diseases, **Didymella Stem and Fruit Rot** (*Didymella lycopersici* Kleb.), **Grey Mould** (*Botrytis cinerea* Fr.) and the **Foot Rot, Root Rot** and propagation troubles, mainly caused by species of *Phytophthora*, were locally very prominent in some areas, but

there were no general trends. **Brown Root Rot** and **Corky Root** were also major problems, and the presence of *Pyrenochaeta lycopersici* Schneider & Gerlach was often confirmed in affected roots.

In 1962 and 1963, an unusual type of fruit infection, involving *Botrytis*, was seen on a Devon nursery. The fungus had penetrated the skin directly and caused pin-point markings together with soft watery areas which tended to split. *Botrytis* was consistently isolated from these areas and the symptoms were reproduced experimentally. Another condition attributed to the same fungus appeared on several Hants nurseries in 1964, being particularly prominent on one on fruits of cv. Eurocross. The fruits, while green, developveloped raised blisters with necrotic centres, a condition often, though not always, associated with ghost spotting.

Improvement in growing techniques and the use of F1 hybrids such as Eurocross, resistant to some of the physiologic races of the fungus had for some time been reducing the significance of **Leaf Mould** (*Fulvia fulva* (Cooke) Ciferri). However, during these last seven years, many Regions have reported from time to time the apparent breakdown of resistant cultivars, following the appearance of new races of the fungus. Few cultivars could be recommended for general use on the basis of continuing resistance to the most prevalent races. Incidence of leaf mould increased markedly in several parts of the country in 1968.

In the Lee Valley, **Blight** (*Phytophthora infestans* (Mont.) de Bary) was more prominent in 1968 than for seven years or so; and in Worcs it was unusually prevalent that year. **Verticillium Wilt** (*Verticillium* spp.) caused relatively few losses.

No **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *lycopersici* (Sacc.) Snyder & Hansen) was recorded during 1957-64. In the next four years a nursery in Devon and another in Sussex had continuing trouble, while other odd reports came from Cumb and Kent. In 1965, fusarium wilt occurred on a Lancs nursery and the following year caused considerable losses among young plants there, the fungus involved was *F. redolens* Wollenw. The extent of the trouble was thought to be associated with under-bench heating. A further outbreak of *F. redolens* in Lancs in 1968 has been reported by Wilcox (*Pl. Path.* 1970, **19**, 98-9) who discussed the seed-borne aspect of the fungus. Another *Fusarium* was associated with a trouble on fruits of cv. Eurocross BB on an Essex nursery in late summer 1966. Large sunken, creamy-white areas developed on otherwise red fruits and, after an incubation period, *F. culmorum* (W. G. Smith) Sacc. grew out. Green fruits developed whitish areas after being inoculated with this fungus. It was suggested that high temperatures might have scalded the fruits and that colonisation of the areas by *F. culmorum* had prevented the formation of red pigment.

A few records of minor fungi are of interest. *Trichothecium roseum* Fr. was associated with **Fruit Rot,** at the calyx end, in a crop of cv. Moneymaker in Devon. In 1951, this fungus had been found causing a stem-end rot of tomato fruits in Herts (Taylor, *Pl. Path.* 1952, **1**, 102) and in 1953 a calyx-end rot in Worcs. In 1967, the tissues of ripe fruit on a holding in Worcs showed a watery breakdown, and the presence of *Oospora lactis* (Fres.) Sacc. was confirmed: very high July temperatures probably encouraged the infection.

'Weed' fungi are sometimes a nuisance. In 1962 in the south-west, a brown mould growing on the surface of whalehide pots, and also on the soil in them,

made the pots too unsightly for sale. Similar instances were said to occur from time to time but attempts to control moulds of this kind with available fungicides had never been successful. In 1963, *Pyronema omphalodes* (Bull.) Sacc., characterized by its small coral-pink or scarlet fruit bodies, covered the surface of compost on a Yorks E.R. nursery: the lower vigour of plants in the affected areas was attributed to nitrogen starvation. Also this fungus was troublesome at one place in the Yorks and Lancs Region in 1964: seedlings in whalehide pots were badly stunted following copious growth of *P. omphalodes* through the compost. Again the fruiting bodies were conspicuous on the soil surface. The fungus was known to occur commonly on burnt or over-sterilized soil but in this instance the compost gave no trouble in earthenware pots and the whalehide containers seemed to be implicated. Another example of competition from soil fungi to tomatoes growing in whalehide containers occurred in the same Region in 1963. In this case the soil was very wet: a species of *Aspergillus* (probably *A. terreus*) which had grown on the whalehide was being succeeded by *Trichoderma viride* Fr. **Giant Puff Ball** (*Lycoperdon* sp.) was a nuisance, in 1962, in a glasshouse in Glos where it was coming up between tomato plants.

Since the 1940's, **Bacterial Canker** (*Corynebacterium michiganense* (E.F. Sm.) Jensen) has made only the odd appearance: it was recorded in Sussex in 1968. Species of *Pseudomonas* were associated with a vascular wilt of cv. Eurocross B, grown in soils trenched with straw and which had received high nitrogen, in Carms in 1964.

Mosaic (tobacco mosaic virus) continued to be a widespread and major problem in tomato production. In 1963 it was notably prevalent in southern counties and the severity of the symptoms, especially on cv. Eurocross drew comment from the south-west and the Eastern Region. In the Lee Valley, 1965 was the worst year for fruit bronzing for some time while, in the Eastern Region generally, mosaic was the main problem in 1966 and fruit disorders associated with the virus were particularly frequent there in 1968. Mosaic increased tremendously in Wales in the mid -60's.

An unusual type of non-parasitic scorch occurred in late-planted cvs. Eurocross and Eurocross B in unheated glasshouses on several nurseries in Lancs and Yorks in July 1963. Young leaves had a black or purplish marginal discoloration, the affected tissues finally collapsing. Sometimes the growing point was killed. Many plants recovered but set no fruit on a few trusses. Growth was rather soft: earlier-planted, harder growing, Eurocross were unaffected. Although plants with severe mosaic were predominately involved, the association was not consistent and, as the plants had been growing in almost continually dull cloudy conditions, the trouble was attributed to the effect of occasional bursts of bright sunshine to which the plants were not accustomed. A similar scorch was noted in Eurocross cultivars in the two following years.

The use of straw, either as bales or incorporated into soil borders, has occasionally resulted in damaged crops when the cereal crops from which the straw came had been treated with herbicides containing TBA.

Chimaera appeared to be more widespread and severe in the Lee Valley in 1967, especially in F1 cultivars: when TMV was also present a severe leaf rolling of affected leaf tissue often resulted. Other minor non-parasitic troubles not previously mentioned for some time were **Oedema,** reported

in a new automatically ventilated, aluminium house in which atmospheric moisture was high, **Zinc Toxicity,** showing as a terminal leaf scorch and attributed to drip from zinc-coated wires, **Sun Scald** of foliage in a house kept tight shut during very sunny weather and severe **Boron Deficiency** on a holding where the plants were growing on straw bales.

A 'bush-head' condition in cv. Moneycross was encountered in the Evesham Area in mid-May 1967. The growing point failed to develop, so that the top of the plant looked bunched, and foliage was distorted. Plants were stunted, and side shoots near the top became dominant, giving some difficulty when plants were trained. Almost every Moneycross plant in a number of crops showed this condition, yet other cultivars, including Eurocross, in the same houses were normal. Similar symptoms occurred on two nurseries in the Area in May 1968: leaves bore prominent yellow spots. Again Moneycross was affected while Eurocross cultivars in the same houses were not. It was noticed in 1968 that affected houses were inadequately ventilated during periods of high and fluctuating temperatures. The condition was noted in two plants of cv. Dutch Victory in Kent in 1964; and in Moneycross, Moneymaker, and Eurocross in Cambs and Norfolk in 1968, where leaves showed yellowish green, roughened areas, and abnormally high temperatures in the glasshouses were believed to be associated.

Leaf abnormalities, sometimes together with yellow spotting and a grey necrotic spotting of leaves and petioles have been seen on several occasions. Eurocross or G.C.R.I. cultivars have been involved. In six nurseries in Wales in 1963 abnormal leaflets developed at the fourth or fifth truss stage. The leaflets were twisted and curled on one side of the compound leaves. Although the symptoms resembled those caused by hormone weedkillers, there was no such association in these cases.

Vegetable Marrow

There were a few reports of the fruit rot attributed to **Grey Mould** (*Botrytis cinerea* Fr.). **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) seems to have attracted no attention on this host since the report by Rees many years ago (*Welsh J. Agric.* 1925, **1**, 188). During these years, the disease affected every plant in a 120 ft x 10 ft glasshouse in Sussex, and caused extensive rotting of marrows in two crops in Berks and Som respectively. **Damping-off** (*Pythium* sp.) was reported from I. of Ely, Sussex and Oxon, and **Root Rot,** attributed to the same fungus, from Surrey, Glos and Denbigh. In the Glos outbreak, a species of *Phytophthora* was also involved. **Gummosis** (*Cladosporium cucumerinum* Ell. & Arth.) is not at all common on vegetable marrow, but was confirmed on a crop of cv. Emerald Green in Kent in 1967.

Watercress

Crook Root (*Spongospora subterranea* (Wallr.) Lagerh. f. *nasturtii* Tomlinson) (Plate III, 2) was the major problem. November 1967 brought the first report of **Leaf Spot** (*Septoria sisymbrii* Niessl. apud Rabenh.) in Britain. Shipton (*Pl. Path.* 1968, **17**, 189) has given the details. The disease

first occurred in plants in a garden in the south-east, but in 1968 reports of infection on commercial crops began to come in. Following the finding of leaf spot on a crop in Hants (*loc. cit.*), it was found on all 12 holdings visited in the Andover area in November 1968 and also elsewhere in the county of Hants: two holdings went out of production in October and there was much anxiety. The disease was widespread in Dorset and Wilts too but was not severe. A few old leaves were infected on two nurseries in Sussex, but no infection was found in the Lee Valley in autumn 1968.

Watercress on a large farm in Hants was severely affected by an overall growth of the **Alga** *Ulothrix* in 1967; young plants were being suffocated. A prolonged period of sunny weather, and the stagnant water in the beds, were thought to be associated factors.

Extensive distortion of leaves was seen in most crops examined in Herts in spring 1968. The small raised areas which covered the leaves, particularly the youngest, seemed to have resulted from cell increase and enlargement. No pathogen was found but areas of the beds where crook root was also present were the worst affected; many of the beds showed typical symptoms of frost injury.

Diseases of Fruit

Apple

Powdery Mildew (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) was the major disease problem, and the quest for effective fungicides was intensified. In the south-east, mildew was becoming increasingly troublesome. The **Scab** (*Venturia inequalis* (Cooke) Wint.) years were 1963 and 1966, but this disease was troublesome in Midland and eastern areas in 1962, 1965 and 1967. The significance of **Canker** (*Nectria galligena* Bres.) increased considerably in the last two or three years of the period, causing much concern and interest in fungicide spray and paint applications.

Collar Rot (*Phytophthora cactorum* (Leb. & Cohn) Schroet. and *P. syringae* (Kleb.) Kleb.) had become one of the major problems in orchards of cv. Cox's Orange Pippin in Essex and appeared to be increasing in eastern counties in the early 1960's. Once mainly a problem in Cox, collar rot has been found in many other cultivars, though Cox is affected worst. Sewell and Wilson (*Rep. E. Malling Res. Stn, 1963*, 190-2: *Nature, Lond.* 1963, **200**, 1229) reported that *P. syringae* had often been isolated from cultivars other than Cox. They referred to records of this fungus from Essex, Kent, Suffolk and Sussex, commenting that it might even be more widespread in England than *P. cactorum*. Sewell and Wilson have further compared the two species (*Ann. appl. Biol.* 1964, **53**, 275-80).

Other fungi featuring quite often in reports were **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer), **Bud Rot** (*Gibberella baccata* (Wallr.) Sacc.) and **Blossom Wilt** (*Sclerotinia laxa* Aderh. & Ruhl. f. *mali* (Wormald) Harrison).

Surveys of Cox's Orange Pippin apples in refrigerated stores were made during 1961-5 by the Advisory Plant Pathologists of the N.A.A.S. The results have been reported by Preece (*Pl. Path.* 1967, **16**, 176-80): the importance of **Bitter Rot** (*Pezicula* (*Gloeosporium*) spp.) was apparent. Other fungal rots most frequently recorded in routine reports were **Brown Rot** (*Sclerotinia fructigena* Aderh. & Ruhl.), **Eye Rot** (*Nectria galligena* Bres.) and **Dry Eye Rot** (*Botrytis cinerea* Fr.).

The perfect stage of *Gloeosporium perennans* Zeller & Childs, *Pezicula malicorticis* (Jackson) Nannfeldt, was found on artificially induced cankers in an orchard near Nottingham (Sharples, *Pl. Path.* 1962, **11**, 180-2). It was the first recorded occurrence of the apothecia on orchard trees: the previous report (see p. 118) had concerned detached branches in storage.

Verticillium Wilt (*Verticillium dahliae* Kleb.) was confirmed in rootstocks from a Flints site in 1966: a quarter of 500 stocks was dead. Although *V. alboatrum* has been confirmed in this host (p. 117), no previous records of *V. dahliae* in this country have been found.

A species of *Cytospora* was associated with a **Bark Canker** condition in cvs. Laxton's Fortune, Tydeman's Early Worcester and Egremont Russet in Kent late in 1968. Infection was general at the 60 per cent level. *Cytospora* on apple was not reported in Part I but has, earlier, been associated with

die-back of apple trees in several areas (Moore, *Br. Parasitic Fungi*, p. 126).

Up to 1961, **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) had been recorded in apple, only in two private gardens (p. 120). Later, an infected tree was found in a third garden, but in 1967, the first attacks in commercial apple orchards (two in Suffolk, two in Kent) occurred (Lelliott, *Pl. Path.* 1968, **17**, 48). In 1968 the disease was severe on a Suffolk farm. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was noted in Suffolk and the west Midlands. Bacteria isolated from frost-damaged apple blossoms were found by Garrett to be predominantly oxidase-negative fluorescent species of *Pseudomonas* (*Rep. E. Malling Res. Stn, 1967*, 139-40).

Apple **Rough Bark** virus was newly recorded for Britain (*Rep. E. Malling Res. Stn*, 1962, 27). In 1959, small russetted ring-like areas were noted on fruit from a single tree in Norfolk: later the disease was confirmed as **Russet Ring** and was reported to have been seen in cvs. James Grieve, Worcester Pearmain and Stark Earliest in English orchards (Posnette and Cropley, ibid. *1963*, 117-8). Russet ring is associated with apple leaf pucker virus (*Phytopath. Papers*, No. 9, 1968, C.M.I.). An outbreak on cv. Laxton's Superb was recorded in 1965 in the Evesham Area. **Chat Fruit** (apple chat fruit virus) was detected in apple rootstock clones MIV and MVII, but not in others, tested in East Malling stoolbeds (Posnette and Cropley, *Ann. appl. Biol.* 1965, **55**, 439-45). The cultivar Tydeman's Early Worcester has been increasingly subject to a small-fruit disease of possible virus origin: the condition is prevalent in England and may be due to a virulent strain of chat fruit virus (*Rep. E. Malling Res. Stn, 1968*, 137-41). A virus complex involving three viruses, apple chlorotic leafspot, apply Spy 227 epinasty and decline and apple (virginia crab) stem pitting, but without symptom expression, occurs in nearly all cultivars of commercial apples (Posnette and Cropley, ibid. *1964*, 150-1). All established apple scion cultivars are affected with apple chlorotic leafspot virus (ibid. *1963*, 115-6): further knowledge was gained about this and the other latent viruses mentioned and also apple stem grooving (E36) virus and apple (Malus) platycarpa scaly bark virus (Campbell, *J. hort. Sci.* 1963, **38**, 15-9; Cropley, *Ann. appl. Biol.* 1968, **61**, 361-72).

Apple **Star Crack** virus appears to spread rarely and its distribution remains restricted. **Mosaic** has been shown to be caused by a virus related to prunus necrotic ring spot virus (de Sequira, *Virology*, 1966, **31**, 314-22), which appeared not to have been reported as of natural occurrence in the Pomoideae.

In Berks, a disease resembling apple **Green Crinkle** (virus) was noted in 1965 in cv. Lord Derby fruits and in 1967 in cv. Herrins Pippin. Green crinkle occurs in several other parts of the world but had not yet been confirmed in this country.

Bitter Pit seemed to be particularly prominent in 1967: a 'lenticel blotch pit', assumed to be of similar origin to true bitter pit, was noted to some extent in most growers' fruit in the west Midlands that year. Observations were made on outbreaks of **Watercore Breakdown** in mature cvs. Red Miller and Miller's Seedling fruits in 1966 (Sharples, *Pl. Path.* 1967, **16**, 119-20). Symptoms attributed to **Manganese Toxicity** were common in the south-east in 1965, especially on Cox's Orange Pippin. The trees showed bark blistering, leaf wilting and discoloration of the phloem and wood. Frequently the trouble was followed by canker (*Nectria galligena*). The 1964

drought was thought to have been a predisposing factor. Die-back in cv. Lord Lambourne in 1968 in the Evesham Area was attributed to the same cause. **Jonathan Spot** and **Brown Heart** were among other troubles noted. In 1964 up to half the fruits on half a dozen Cox's Orange Pippin trees showed **Flat Fruit** (genetical) in a Kent orchard.

Only in recent years has **Replant Disease** been recognized as an important problem in apples in this country (Savory, *Rep. E. Malling Res. Stn, 1966*, 205-8; *Agriculture, Lond.* 1968, 75, 80-3).

Pear

The main disease was fireblight, and the others most frequently troublesome were **Canker** (*Nectria galligena* Bres.), **Scab** (*Venturia pirina* Aderh.) and **Bacterial Blossom Blight** (*Pseudomonas syringae* van Hall). Three types of blossom infection by *Ps. syringae* have been reported (Panagopoulos and Crosse, *Rep. E. Malling Res. Stn, 1963*, 119-22; *1964*, 24).

The development of **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) in England up to 1961, after its first detection here in 1957, is described on p. 125. The following details of the position from 1962-6 has been extracted from R.A. Lelliott's contribution to an international conference on the disease, organized by E.P.P.O. (EPPO Publications, 1968, Ser. A. No. 45-E, 10-14).

"During 1961-1965, the policy of containing the disease was largely successful in fruit areas: in Kent the disease was, in general, restricted to the north-west of the county and most of the occasional outbreaks outside this area were eliminated; in Essex it reached the fruit area in 1961 but spread was contained; in London and the surrounding counties spread continued in ornamentals and hawthorn scrub; the outbreak in Wisbech was eradicated in 1961, as was another in Hampshire. . . . . .

In 1966 the amount of secondary blossom produced was abnormally high. It occurred in many varieties that normally produce only small amounts and was unusually high in varieties in which secondary blossom production is a characteristic. Fireblight spread rapidly across Kent to the English Channel and from Essex into Suffolk. At the end of the year it was occurring throughout the fruit-growing areas of these counties, which contain about two thirds of the English pear acreage. An isolated outbreak was found in S. Wales in hawthorn. Obviously the policy of containment had failed and in 1967 efforts were concentrated in the less affected areas in order to slow down the rate of spread there".

In 1967, infection was discovered for the first time in commercial apple orchards (p. 255). In 1968 incidence in pear was generally low: in this year control on an advisory basis began to replace statutory control.

Several fungus diseases, absent from the 1957-61 records, were mentioned in reports of the later years. *Phoma limitata* (Peck) Boerema (syn. *Phyllosticta mali* Prill. & Delacr.) was associated with grey brown lesions on the leaves of a tree in a garden in Wilts in 1968: although not uncommon as a cause of leaf spot in apple the fungus appears not to have been recorded previously on pear in this country. *Nectria cinnabarina* (Fr.) Fr. the cause of **Coral Spot** was noted on unthrifty trees. **Leaf Fleck** (*Mycosphaerella sentina* (Fr.) Schroet.) was confirmed in several cultivars on a holding in Worcs: while

Bristol Cross was defoliated prematurely, Gorham showed leaf flecking only and Conference was hardly affected. Also recorded were **Leaf Blight** (*Fabraea maculata* Atk.) and fruit rots caused by *Penicillium* sp. and *Rhizopus* sp.

In Part I, *Verticillium dahliae* Kleb. was recorded on this host. In 1966, the fungus was confirmed in Flints in a plantation of 200 trees, a quarter of which was dead, on quince rootstocks. In 1967 the fungus was again isolated from rootstocks in Flints. Some severe attacks by **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) developed on perry cultivars in Som in 1967.

Black Mould (*Cladosporium herbarum* (Pers.) S. F. Gray) caused spots on many fruitlets of cv. Conference in a Worcs orchard in 1962: cv. Laxton's Superb, growing alongside, was unaffected. Only those fruitlets yellowed prematurely following frost injury were spotted, and none of the developing fruitlets bore the fungus. *C. herbarum* had not previously been noted on pear in this country but there has been the odd report on apple fruits (see p. 120). There have been a few further records of **Bitter Rot** (*Pezicula malicorticis* (Jacks.) Nannf. syn. *Gloeosporium perennans* Zeller & Childs) affecting pear fruits: the first records on pear are given on p. 124. **Canker** (*Gloeosporium* sp.) was noted in Ches in 1966 in the same orchard as is mentioned on p. 124. A species of *Mucor*, probably *Mucor strictus* Hagem. was found in 1964 causing a rot of cv. Conference pears: the rot developed during the ripening period after storage in air (Edney, *Pl. Path.* 1965,**14**, 189-90).

Reports of **Blister Canker** (pear blister canker virus) (see p. 127) came from a few places in the east and south-east.

Symptoms closely resembling **Rough Bark** (pear rough bark virus) were seen in a three-year old planting in the west Midlands: about 10 per cent of 450 cv. William's Bon Chrétien trees with 2 ft Buerré Hardy stems on quince A rootstocks showed severe cankering and splitting of the Buerré Hardy stems and slight cankering on the William's scion. A number of the trees had died. The virus is thought to be a strain of pear blister canker virus and is known to occur in England (*Virus Diseases of Apples and Pears*, p. 107, Technical Communication No. 30. C.A.B., Farnham Royal.)

The unsuitability of the clonal quince rootstocks D,E,F, and G for pear propagation has previously been attributed to 'incompatibility' but it has now been shown that D,E,F, and G are killed by the quince sooty ring spot and apple chlorotic leafspot viruses prevalent in pears, and it seems likely that sensitivity to these viruses latent in pear scionwood accounts for decline and death of pears propagated on those rootstocks (Cropley, *J. hort. Sci.* 1967, **42**, 113-5).

Plum

Most frequently reported were **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), **Bacterial Canker** (*Pseudomonas morsprunorum* Wormald)—particularly prominent in 1961, **Brown Rot** (*Sclerotinia fructigena* Aderh. & Ruhl.) and **Blossom Wilt** (*Sclerotinia laxa* Aderh. & Ruhl.); while **Rust** (*Tranzchelia pruni-spinosae* (Pers.) Diet.)* was particularly noticeable in 1965, in the west, and in 1967 in the west Midlands.

* see footnote p. 128.

A species of *Cylindrocladium* was isolated from affected plants in a layer bed of St. Julien A showing **Shoot Wilt** in 1967. The wilted shoots eventually died back. Some years ago a fungus very similar to *C. scoparium* Morgan was found to be causing a similar trouble in various *Prunus* fruit trees, including plum, at East Malling (Wormald, *J. Pomol.* 1943, **20**, 80-3; *Trans. Br. mycol. Soc.* 1944, **27**, 71-80). **Die-back** (*Diaporthe perniciosa* Marchal) of the shoot tips of cv. Burbank occurred in an orchard in Worcs in 1968. Damage to the surface roots by shallow cultivations was thought to have checked growth and to have allowed infection to become established. *D. perniciosa* has previously been associated with die-back of apple, pear etc. *Stereum hirsutum* (Fr.) Fr., usually saprophytic, but sometimes a wound parasite of wood of various trees, appeared to be affecting the ends of branches of cv. Marjorie's Seedling at one site in the Evesham Area early in 1967. A new host record for the *Gloeosporium fructigenum* Berk. stage of *Glomerella cingulata* (Stonem.) Spauld. & Schrenk) came in 1964 with the occurrence of the fungus on fruit on a few trees of cvs. Pershore Yellow Egg and Purple Pershore in a large garden orchard in Caerns.

Bacterial Shoot Wilt (*Pseudomonas syringae* van Hall) had affected 100 young trees of several cultivars in an orchard in the Evesham Area, and was extensive in two small orchards in Kent and Surrey respectively. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was noted.

The virus disease **Plum Pox** or Sharka (plum pox virus) was found at East Malling Research Station in 1965 and 1966 in two young Italian prune plum trees (Cropley, *Pl. Path.* 1968, **17**, 66-70). It had apparently been introduced from Europe in plum rootstocks. The diseased trees were destroyed and surveys were conducted at East Malling and elsewhere, but no further infection was found during this period. Plum pox is a serious disease in Eastern Europe and has recently been spreading westwards on the Continent. A disease resembling, but distinct from, plum pox had been found earlier in England (see p. 129): apple chlorotic leafspot virus is probably responsible for this disease (*Rep. E. Malling Res. Stn, 1966*, 35). Certain virus isolates from plum trees with **Line Pattern** disease, capable of reproducing line pattern in *Prunus* hosts, have been shown to be closely related to apple mosaic (strain of prunus necrotic ring spot) virus (ibid. *1968*, 39). **Plum Stunt** (see p. 130), which causes gradual decline and death of cv. Marjorie's Seedling on Myrobalan rootstocks was under investigation: two strains of prunus necrotic ring spot virus were isolated from diseased trees (ibid. *1965*, 47). **Strawberry Latent Ring Spot** virus was isolated from a plum tree in a derelict orchard in Berks (ibid. *1966*, 35), and had been found in Scotland in plum propagated from material sent from Surrey (Lister, *Ann. appl. Biol.* 1964, **54**, 167-76).

Damson

Witches' Brooms (*Taphrina institiae* (Sadeb.) Johans.), not seen during 1957-61, but occasional in this host, was seen in the Evesham Area in 1965.

Cherry

Silver Leaf (*Stereum purpureum* (Fr.) Fr.) and **Bacterial Canker** (*Pseudomonas morsprunorum* Wormald) were the diseases most frequently

encountered by advisers, and virus diseases are particularly important (see below). Bacterial canker was notably severe in the Wye Sub-Region in 1966.

Verticillium dahliae Kleb. has rarely been recorded on cherry, but in 1966 it was isolated from three dead cherry trees in Flints. Severe **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was noted on occasions. Particular attention has been paid to the virus diseases in English sweet-cherry orchards (Posnette, Cropley and Swait, *Ann. appl. Biol.* 1968, **61**, 351-60). In the opinion of the workers quoted, the high virus incidence and ensuing depression in yield is likely to have reduced potential yields by at least 30 per cent and to have contributed to the lessening of the sweet cherry acreage. In their tests, **Little Cherry** (cherry little cherry virus) and the **Necrotic Ring Spot** (prunus necrotic ring spot virus)-**Prune Dwarf** (prune dwarf virus) complex (see also Cropley, Gilmer and Posnette, *Ann. appl. Biol.* 1964, **53**, 325-32) were of the widest occurrence: also commonly found were **European Rusty Mottle** (cherry rusty mottle virus) and **Ring Mottle** (cherry ring mottle virus), while **Necrotic Rusty Mottle** (cherry necrotic rusty mottle virus), reported on p. 132 as Frogmore virus canker, was less prevalent. However, necrotic rusty mottle is known to be widespread and sometimes the cause of poor production in cultivars such as Frogmore, Florence and Noble (Posnette and Cropley, *Pl. Path.* 1964, **13**, 20-2).

Posnette, Cropley and Swait (*loc. cit.*) found that most trees of cultivars commonly grown before 1920 were infected with one or more viruses while most trees of cultivars introduced since 1920 were virus free.

Little cherry is known to be widely distributed in sweet cherry trees in Kent (Posnette, *Pl. Path.* 1964, **13**, 170-2) and it occurs in Worcs and Berks. This virus is prevalent in ornamental *Prunus* (Cammack, *Pl. Path.* 1966, **15**, 31-3).

It is now concluded that **Rasp Leaf** (see p. 132) can become prominent when prune dwarf virus and raspberry ring spot virus (RRSV) occur together; for example if trees containing prune dwarf were planted in land containing the eelworm vector *Longidorus* which was carrying RRSV, or if prune dwarf virus were to spread into trees already infected with RRSV (Cropley, *Ann. appl. Biol.* 1964, **53**, 333-41). In many orchards rasp leaf is quite unimportant but when either of the component viruses spreads quickly an orchard can become worthless in a few years (Cropley, *Scient. Hort.* 1968, **20**, 95-100). Apple chlorotic leafspot and prunus necrotic ring spot viruses (see p. 132) were transmitted from cherry with the **Necrotic Line Pattern** syndrome (*Rep. E. Malling Res. Stn, 1965*, 46).

Replant Disease of cherry is a longstanding problem of unknown origin and its effects are apparent when cherry trees are planted on sites previously occupied by cherries or plums (Savory, *Agriculture, Lond.* 1968, **75**, 80-3; *Rep. E. Malling Res. Stn, 1966*, 205-8).

Peach

The most prominent disease, **Leaf Curl** (*Taphrina deformans* (Berk.) Tul.), seemed particularly heavy in some areas in 1962. Also recorded were **Scab** (*Venturia carpophila* Fisher syn. *Fusicladium carpophilum* (Thüm.) Oudem.), **Canker** (*Cytospora* sp.) (see p. 133) in Berks in 1965, a severe attack of

canker (*Diaporthe perniciosa* Marchal) also in Berks, and **Black Mould** (*Rhizopus stolonifera* (Fr.) Lind) of fruits, previously seen in Jersey (Moore, *Br. Parasitic Fungi*, p. 329).

Apricot and Nectarine

No apricot diseases were recorded in Part I (1957-61).

The odd attack of **Shoot Wilt** (*Sclerotinia laxa* Aderh. & Ruhl.) was recorded on both apricot and nectarine, **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) on apricot, and **Scab** (*Venturia carpophila* Fisher) on nectarine.

Fig

Coral Spot (*Nectria cinnabarina* (Fr.) Fr.) was noted.

Walnut

The non-parasitic trouble **Soft Shell** was mentioned. This trouble is described by Moore in *Bull. Minist. Agric. Fish.* No. 126, 1944, p. 73 and Fig. 12).

Cob Nut

Bud Rot and Twig Canker has been shown to be caused by a species of *Gloeosporium* (see p. 134). In 1962 bud rot was prevalent, but not severe, in an old plantation in Glos; it had previously been recorded in the South-western Region. In 1963 most trees were affected in a 2-acre plantation in Kent and the disease was confirmed in wild hazel in Yorks W.R.

Quince

Leaf Blight and Fruit Spot (*Fabraea maculata* Atk.) did not come to the attention of advisers in 1957-64, but during 1965-8 attacks were reported from the south-east, south-west, Cambs, Lincs, Herefs and Glos. *Verticillium dahliae* Kleb. was isolated from quince rootstocks on a nursery in Flints: a quarter of the 200 plants was dead when the nursery was visited in 1966 but the main trouble appeared to be the high water table, with land subject to flooding in winter. *V. dahliae* occurs frequently in quince A rootstocks in the nursery at East Malling (*Rep. E. Malling Res. Stn, 1962*, 26).

Natural spread of **Apple Chlorotic Leafspot** virus is known to occur in quince (Posnette and Cropley, ibid. *1963*, 115-6).

Mulberry

Mulberry diseases received no comment during 1957-61. In 1964, the uncommon **Canker** (*Gibberella moricola* (de Not.) Sacc.) was noted in gardens in Hants and Sussex.

Grape Vine

Most commonly occurring were **Powdery Mildew** (*Uncinula necator* (Schw.) Burr.) and **Grey Mould** (*Botrytis cinerea* Fr.).

After an absence from reports for a few years the following have again received mention. **Downy Mildew** (*Plasmopara viticola* (Berk. & Curt.) Berl. & de Toni) was seen in Som, **Ripe Rot** (*Glomerella cingulata* (Stonem.) Spauld. & Schrenk) in N. Wales on the same holding as on plums (p. 258), and **Leaf Spot** (*Septoria* sp.) at a site in Cardiff: *S. Badhami* Berk. & Br. (see Moore, *Br. Parasitic Fungi*, p. 355) has been recorded on vine in this country.

Melon

A further record of **Verticillium Wilt** (*Verticillium dahliae* Kleb.) came from Sussex in 1965 where the disease was severe in ½-acre of cv. Agen. **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was troublesome on a Sussex holding, and **Cucumber Mosaic** virus was found in cv. Tiger in Glos.

Black Currant

Leaf Spot (*Pseudopeziza ribis* Kleb.) was severe generally, and above average, in many areas in 1963. In 1962, late attacks were often severe. In 1964, 1967 and 1968 it was very prominent, but in some areas only. Much attention was being given to the epidemiology of this disease.

In earlier years, **American Mildew** (*Sphaerotheca mors-uvae* (Schw.) Berk. & Curt.) was reported quite often but was not regarded as of great consequence. In 1962 some attacks in the east were extensive; and in 1963 it was worse than usual on shoot tips in Suffolk, and some very heavy infections developed in Kent and E. Sussex where it became epidemic in a number of crops during August. By 1964 it had become a serious problem for the first time in the south-west. During the remaining years, infection was widespread, and in some areas severe. In 1966 it was first reported in N. Wales. The rise in significance of this disease to become a major problem caused particular concern where growers were developing alternate-year systems of cropping for harvesting by machine.

Grey Mould (*Botrytis cinerea* Fr.), affecting fruit or causing canes to die back, was another important cause of losses; and **Rust** (*Cronartium ribicola* J. C. Fischer) was mentioned in many reports.

Not mentioned in Part I were **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) which was noted on a few occasions, and **Leaf Spot** (*Mycosphaerella ribis* (Fuckel) Kleb.) which was noted in Glos. On two occasions, the **Slime Mould** *Mucilago spongiosa* Morgan was noticeable on bushes.

Reversion (black currant reversion virus) was still the only virus disease of economic importance. Sixty per cent of 81 plantations in Eastern England were found to contain reverted bushes in a survey in 1965 (Legowski, *Pl. Path.* 1966, **15**, 90-5). A virulent strain of reversion virus was discovered at numerous localities (*Rep. E. Malling Res. Stn, 1965*, 47). A vein pattern effect on leaves, associated with reversion has also been noted (Thresh, *Rep. E. Malling Res. Stn, 1962*, 97-8). Other viruses were recognized in

black currants (ibid *1963*, 31) *viz.* **Gooseberry Veinbanding** virus, which is widely distributed; black currant **Variegation** virus; the rarely recorded black currant **Yellows** virus; and **Green Mottle** (cucumber mosaic virus) which was later (ibid. *1964*, 31) known to occur in several localities but in a few bushes only. The rare black currant **Vein Net,** and black currant **Vein Clearing** which had been recorded in several counties, were also mentioned in ibid. *1963*, 31 but are now considered to be induced by gooseberry veinbanding virus (*Phytopath. Papers*, 1968, No. 9, p. 51. Kew. C.M.I.) .

Thresh (ibid. *1965*, 158-63) gave information on, and discussed the economic significance of, the above black currant viruses together with raspberry ring spot, which had not been found naturally, arabis mosaic virus (see below) and strawberry latent ring spot virus only recorded in Scotland.

The variegation virus is common particularly on widely grown cultivars such as Daniel's September Black and Seabrook's Black (Campbell and Adam, *Rep. agric. hort. Res. Stn Univ. Bristol*, *1967*, 104-9).

Arabis Mosaic virus was first confirmed in black currant, by J. M. Thresh, in a crop in Oxon in 1965 and has been found in Berks and (ibid. *1966*, 36) Herefs.

Red Currant

Apart from virus diseases, and diseases already referred to in Part I, only **Die-back** (*Botrytis cinerea* Fr.) was noted.

Thresh (*Rep. E. Malling Res. Stn*, *1966*, 146-52) reviewed the virus situation. **Gooseberry Veinbanding** virus is very widespread generally, while **Red Currant Mosaic** (**European**) and **Arabis Mosaic** viruses are relatively common in the National Fruit Trials. Other viruses mentioned by Thresh as recorded in Britain on single occasions and apparently of little economic significance were black currant **Reversion** virus (on *Ribes nigrum* var. *pubescens* at East Malling), cucumber mosaic virus causing **Green Mottle; Strawberry Latent Ring Spot** and **Raspberry Ring Spot** viruses. **Interveinal White Mosaic,** recorded twice, may be caused by alfalfa mosaic virus (*loc. cit.* and ibid. *1967*, 42).

Gooseberry

American Gooseberry Mildew (*Sphaerotheca mors-uvae* (Schw.) Berk. & Curt.) and **Leaf Spot** (*Pseudopeziza ribis* Kleb.) were the most prominent fungal diseases. **Die-back** (*Botrytis cinerea* Fr.) and gooseberry **Veinbanding** virus were commonly reported.

Verticillium Wilt (*Verticillium dahliae* Kleb.) was confirmed for the first time in this country in 1964. In a small plantation, planted in Worcs in 1962, the four-year-old bushes of cv. Keepsake yellowed and were defoliated the following summer. By January 1964, about one-third were dead or partially so. All those examined showed blackened vascular tissue low in the stems and in the roots, and *V. dahliae* was isolated in every instance.

By March 1963, **Root Rot** (*Rosellinia* sp.) had spread fairly rapidly in an area of young bushes planted at the end of 1961 in Norfolk. The comparatively harmless **Twig Speckle** (*Phoma suspecta* Mass.) (see Wormald, *Diseases of Fruits and Hops*, 1955, p. 206. London: Crosby Lockwood) was noted in reports.

Oedema (non-parasitic) was noted in specimens from Berks. The dark grey-brown blistering occurred on the undersides of the leaves and was said to resemble symptoms seen in the dry season of 1959. No mites or pathogens were present. **Sun Scald** was also recorded.

Strawberry

Red Core (*Phytophthora fragariae* Hickman) remains subject to the Red Core Disease of Strawberry Plants Order 1957. Since 1964, surveys have been made by the Plant Health and Seeds Inspectorate of the M.A.F.F., to check on incidence. Particular attention was paid to certain areas to see if red core was more widespread than had been thought. Only in Hants were undue numbers of previously unrecorded outbreaks found; the disease was known to be well established there and there is much local movement of strawberry runners. Almost half of the 60 premises surveyed in Hants was found to have infected crops. In Kent and Sussex there was some evidence of further spread, and a few outbreaks were discovered in the west Midland, Essex and Denbigh areas. Elsewhere, including the south-west, hardly any infection was found.

The pathogenicity of 27 British isolates of *P. fragariae* has been described, and nine physiologic races characterized (Montgomerie, *Trans. Br. mycol. Soc.* 1966, **50**, 57-67).

The other major fungal diseases were **Powdery Mildew** (*Sphaerotheca macularis* (Fr.) Lind), **Verticillium Wilt** (*Verticillium dahliae* Kleb.) and **Grey Mould** (*Botrytis cinerea* Fr.), which latter was a major problem in the west Midlands in 1963 and prominent in some areas in 1965 and 1968. Pest and disease control measures in the Cheddar and Draycott areas of Som were surveyed in 1963-4 (Vernon, Dennis and Tompsett, *Pl. Path.* 1965, **14**, 169-73). Grey mould was considered the most important disease by more than half the growers, 1963 being a particularly favourable season.

Also commonly reported during the seven years were **Leaf Spot** (*Mycosphaerella fragariae* (Tul.) Lindau) and **Leaf Blotch** (*Gnomonia fructicola* (Arnaud) Fall.). From 1964, the latter was responsible for a fruit rot, particularly in cv. Redgauntlet, in the South-eastern Region, and fruit was affected in the east Midlands also. Substantial losses occurred occasionally in Redgauntlet, but otherwise the disease seems relatively unimportant. In the Cheddar area of Som, unusual trouble with the leaf blotch stage was experienced in cloched, and to a lesser extent in polythene-covered, crops of strawberry.

The **Crown Rot** (*Phytophthora cactorum* (Leb. & Cohn) Schroet.) which has been recorded once or twice previously (see p. 141) was reported on several occasions in the south and in Wales. **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) of fruit has been noted previously on one

occasion. In 1964 the large sclerotia of the fungus were apparent on rotted fruits of cv. Cambridge Favourite examined in Devon.

Previously, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. has been recorded on single occasions causing rot of fruits (Scotland) and of roots respectively (Moore, *Br. Parasitic Fungi*, p. 116). In 1967, a severe **Stem and Root Rot** of maiden cv. Cambridge Vigour in Denbigh, and a firm sunken black **Fruit Rot** of cv. Redgauntlet in Hants (Shipton, *Pl. Path.* 1968, **17**, 144) were both attributed to *Rhizoctonia*. In the Denbigh outbreak the plants followed potatoes and conditions were wet. *Pythium* and *Fusarium* spp. have been isolated from rotted roots on occasions but the status of these fungi in strawberries is uncertain. A fungus causing a **Petiole Rot** of cv. Cambridge Rival in Herefs in autumn 1966 was identified as *Didymella lycopersici* Kleb. In the Evesham Area in 1968 the **Slime Mould** *Diachaea leucopoda* (Bull.) Rost. was recorded at a number of places infesting petioles and foliage of runners and plants: on one Worcs nursery it became a problem when it grew over both dead and live foliage.

In 1967 stunting and chlorosis, prevalent in cvs. Redgauntlet and Talisman, was associated with **Yellow-Edge** virus which had been rare for some time (*Rep. E. Malling Res. Stn, 1968*, 39).

Of the other virus diseases, only **Arabis Mosaic** and **Green Petal** (clover phyllody virus) featured prominently in reports. **Strawberry Latent Ring Spot** virus was confirmed in material from Hants (Lister, *Ann. appl. Biol.* 1964, **54**, 167-76), and also in the Evesham Area in 1967 and in Suffolk in 1968.

In the first year or two of the period, **Streaky Yellows** or **June Yellows** (see p. 143) was reported to have been seen more commonly than usual in stocks of cv. Cambridge Favourite in the Midlands and Starcross Sub-Region. **Sun Scald** was noted as severe on the odd cloche-grown and unprotected crop.

D. Wiggell reported a non-pathological **Wilt** of cv. Redgauntlet, resembling verticillium wilt when most severe, which appeared early in July 1968 on many plantations in the Wye Sub-Region. Fruit trusses and leaves had collapsed, the affected trusses bore poor, shrivelled, dried fruits; the calcyes were scorched and brown and the receptacles often had brown necrotic patches at the calyx end. Leaf petioles also showed necrotic spots and blotches, those on the peduncles and pedicels coalescing to form large areas involving the whole fruiting stem. The leaf margins were necrotic, the foliage symptoms superficially resembling those caused by *Gnomonia fructicola*. Crops on the drier, lighter, sandy soils were affected and severity was worse when root growth was impeded by soil pans. In shaded areas of plantations plants grew normally. The condition was thought to be associated with excessive transpiration when soil moisture levels were low.

Raspberry

Spur Blight (*Didymella applanata* (Niessl) Sacc.) caused considerable trouble in the south-east in 1968, while **Cane Spot** (*Elsinoe veneta* (Burkh.) Jenkins) and **Grey Mould** (*Botrytis cinerea* Fr.) were also commonly reported. **Cane Blight** (*Leptosphaeria coniothyrium* (Fuckel) Sacc.) was of

less concern. **Yellow Dwarf** (arabis mosaic virus) was not uncommon; in 1964 it was confirmed by Dr. Cadman in cv. Malling Promise from a plantation in Worcs in which extensive areas were stunted. This cultivar had been regarded as immune.

Powdery Mildew (*Sphaerotheca macularis* (Fr.) Lind), which had drawn no comment for some years, was recorded in several places. A species of *Phytophthora* was detected in plants with **Root and Crown Rot** from a $\frac{1}{4}$-acre crop of cv. Norfolk Giant in Kent in 1963. Species of *Phytophthora* have been recorded in raspberry roots in Scotland (e.g. see p. 145). The single report of **Crown Rot** (*Nectria mammoidea* Phill. & Plowr. var. *rubi* (Osterw.) Weese) since 1957 came from Devon. A species of *Gloeosporium* had completely covered fruits with mould growth in Caerns in 1964, *Botrytis* also being present. **Strawberry Latent Ring Spot** virus was recorded in Ches.

Blackberry

Purple Blotch (*Rhabdospora ramealis* (Desm.) Sacc.) and **Septoria Spot** (*Septoria rubi* Westend.) were the main troubles. **Grey Mould** (*Botrytis cinerea* Fr.) caused an almost complete loss in one crop. A **Cane Gall** similar to that caused in U.S.A. by *Agrobacterium rubi* (see p. 147) was severe in a plantation in the Evesham Area in 1964. **Raspberry Ring Spot** virus was recorded in cv. Himalaya Giant in Essex (*Rep. E. Malling Res. Stn, 1967*, 42).

Loganberry

Death of lateral shoots, which had collapsed and rotted, was attributed to *Botrytis cinerea* Fr. in Worcs: the canes had been left untrained since the previous year. **Fruit Rot** also caused by *Botrytis* was noted; in one instance a whole crop was involved. **Cane Spot** (*Hendersonia rubi* Sacc.) was noted in the odd crop in the south-east, in association with other more pathogenic fungi. A species of *Phytophthora* was isolated from plants showing a **Cane Wilt** and **Crown Rot** in Kent in 1964. **Bushy Dwarf** (strain of apple chlorotic leafspot virus) was diagnosed in a plantation in Holland (Lincs); and **'Mosaic'** (virus) was noted. Symptoms of vein clearing, leaf curling and severe stunting resembling those of **Loganberry Mosaic** in U.S.A. have been seen in England and have been transmitted to loganberry (*Rep. E. Malling Res. Stn, 1968*, 40).

Boysenberry plants affected by **Spur Blight** (*Didymella applanata* (Niessl) Sacc.) were seen in 1967 in Staffs.

Blueberry

Die-back (*Botrytis cinerea* Fr.) was prevalent in May 1962 in various cultivars at a site in Dorset and was noted again in Dorset the following year.

Diseases of Hop and Mushroom

Hop

Information on the incidence of diseases, supplied by the N.A.A.S. Hops Advisers in the main hop-growing areas of the south-east and the west Midlands will be found in the annual reports of the Department of Hop Research, Wye College, for the seven years.

Two particular problems facing advisers arose from the demand from brewers for cultivars yielding very high alpha-acid for the production of hop extract or for 'hop powder'. Growers were seeking advice on replanting of wilt-infected gardens with new cultivars; and changes in cultivar pattern on some farms meant that virus carriers were being planted near to virus-sensitive cultivars.

Attempts to restrict the spread of **Progressive Verticillium Wilt** (virulent strain of *Verticillium alboatrum* Reinke & Berth.) by statutory means were intensified from 1965 following the introduction of a revised order (The Progressive Wilt Disease of Hops Order 1965). The containment areas of northern Kent, the west Midlands and Hants have been surveyed annually by the plant health inspectorate.

From 1965 to 1968, continuing or newly detected outbreaks were reported on some 25 of the more than 100 farms situated in northern Kent. Only eight of these had detectable infection in 1968: seven others had by then ceased to grow hops entirely and two had disbanded the affected gardens.

The farm in Hants on which a severe outbreak was first recorded in 1960 has more recently ceased to grow hops; and no other farm in this relatively small group of farms on the Hants/Surrey border is known to have experienced the disease.

In the other important hop areas in Herefs and Worcs the situation is very satisfactory. Apart from a recurrence in 1962 and 1963 of the wilt on one of the earlier-infected Herefs farms, more recently gone out of hops, no further infection was found until 1967 when a single male plant on a farm in Worcs was proved to have the disease. No other infection has been seen in Worcs before or since.

In the Weald of Kent, where progressive wilt is well established, there seemed to be less spread to clean farms: the acreage of wilt tolerant cultivars in this area was increasing.

Fluctuating Verticillium Wilt (mild strain of *V. alboatrum*, or *V. dahliae* Kleb.) remained a serious problem on some west Midland farms. The 1965 season saw more widespread and damaging infection than in any previous season: incidence in some gardens of cv. Fuggle reached as high as 70 per cent. In the Weald of Kent, outbreaks were severe on sensitives and occurred on some tolerant cultivars. In 1966 the wilt was again widespread in the west Midlands but was late in appearing.

Downy Mildew (*Pseudoperonospora humuli* (Miyabe & Tak.) G. W. Wilson) was above average in the west Midlands in 1966, and spike infection up to 6ft from the ground was commonly seen. A greater importance of the mildew in recent years has been attributed to the much reduced acreage of

cv. Fuggle and the replacement of Fuggle by the wilt-tolerant Whitbread's Golding Variety which seemed particularly prone to the rootstock form of the disease: the susceptibility of W.G.V. had become one of the most serious problems in hop cultivation (Coley-Smith, *Ann. appl. Biol.* 1964, **53,** 129-32; *N.A.A.S. q. Rev.* 1966, No. 72, p. 158). **Powdery Mildew** (*Sphaerotheca macularis* (Fr.) Lind) caused heavy losses of cones in the west Midlands in 1967, after being generally below average the previous season. In the south-east, attacks were very common in early June 1965. **Canker** (*Gibberella pulicaris* (Fr.) Sacc.) was more common than usual in Golding cultivars in 1968 in the south-east. An increase of this disease in recent years was thought to be the result of new cultural practices.

After the earliest known outbreaks, in the 1940's, incidence of **Black Root Rot** (*Phytophthora citricola* Sawada) remained low until 1962 and 1963 when the disease occurred severely on cv. Whitbread's Golding Variety on three farms in Kent. One attack was outstandingly heavy and involved at least 500 plants (Coley-Smith, *Rep. Dep. Hop Res. Wye Coll. 1962,* 18-9). There have been one or two minor outbreaks since, one involving a single plant of cv. Fuggle. Royle reviewed (ibid. *1965,* 39-44) current knowledge of the disease, and later compared isolates from various outbreaks in this country and New Zealand (*Pl. Path.* 1968, **17,** 36-40).

Crown Gall (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) developed on roots of cv. Bullion under mist propagation in Herefs in 1967.

The extensive amounts of **Nettlehead** and of **Split Leaf Blotch** (prunus necrotic ring spot virus) were problems in both the west Midlands and the south-east. During the period, Bock established an apparent relationship between nettlehead and combined infection with arabis mosaic virus and virulent isolates of prunus necrotic ring spot virus (*Ann. appl. Biol.* 1966, **57,** 131-140). He also studied strains of the latter virus (ibid. 1967, **59,** 437-46): all commercially grown hops are now known to be infected with it (*Rep. E. Malling Res. Stn, 1966,* 37) though most show no symptoms. Suspicions that split leaf blotch might be a component of the virus complex involved in nettlehead were not confirmed in the experiments of Legg and Ormerod (*Ann. appl. Biol.* 1964, **53,** 403-6; *Rep. E. Malling Res. Stn, 1968,* 40). The significance of hop line-pattern (arabis mosaic virus) in relation to nettlehead was studied by Legg (*Ann. appl. Biol.* 1964, **53,** 389-403). It had become realized that **Arabis Mosaic** virus was much more widespread in hops than was indicated by the limited distribution of nettlehead.

Hop **Latent Virus** was found in British hop cultivars (*Rep. E. Malling Res. Stn,* 1968, 41).

Mushroom

There were no striking fluctuations in disease incidence, though **White Mould** (*Mycogone perniciosa* Magn.) was locally serious on occasions. Of the diseases not mentioned in Part I, **Green Mould** (*Trichoderma viride* Fr.) was reported from a number of farms, and a species of *Penicillium* had colonized brown areas of caps and stipes in a crop seen in Yorks E.R. in September 1965 and, though prevalent, was probably a secondary invader. A yellow mould, white in the early stages, was noted as a competitor on a farm in Carms: it was identified as *Peziza ostracoderma* Korf. On a farm

in Northants in 1964, *Diplocladium penicilloides* Sacc. was found growing over both the bed surface and the mushrooms, patches of which were rotting. This fungus, the perfect state of which is *Hypomyces aurantius* (Fr.) Tul. had apparently not previously been recorded in this country. Details of the occurrence have been given by Storey (*Pl. Path.* 1935, **14**, 190).

Atypical symptoms of **Brown Blotch** (*Pseudomonas tolaasi* Paine) were seen in a crop in Som. early in 1968. The condition was reminiscent of bacterial pit but *Ps. tolaasi* was confirmed. At the edges of the gills, droplets of mucilage had collected: the gills were darkened and appeared rather waterlogged. Internally, the stipe was slightly discoloured while, on the upper surface of the cap, discrete, dark brown, pit-like markings, 1-2 mm in diameter, were present. Tyroglyphid mites were also noted. A dark discoloration, followed by rotting, of the gills was prevalent on a nursery in Lancs in summer 1968. A species of *Pseudomonas* was isolated from droplets of ooze on the gills.

Studies on **Die-back** (see p. 155) have continued at G.C.R.I. Of 131 samples of mushrooms, from growers or the N.A.A.S., examined by electron microscope in 1968, 63 had one or more viruses (Hollings, Stone and Atkey, *Rep. Glasshouse Crops Res. Inst, 1968*, 105): five viruses were by then recognized as being associated with mushroom disorders.

Diseases of Ornamental and Miscellaneous Plants

Carnation

Although cuttings tested for freedom from wilt-causing organisms have been widely used, **Verticillium Wilt** (*Verticillium cinerescens* Wr.) remained the most important disease of this crop. After a period when the significance of **Fusarium Wilt** (*Fusarium oxysporum* Fr. f. *dianthi* (Prill. & Delacr.) Snyder & Hansen) had been slight, this disease also became quite common in the Lee Valley and the south-east from about 1965 onwards, and in 1967 it spread considerably in affected nurseries. Nurseries in the Evesham Area had more than usual in 1968. Another *Fusarium*, *F. redolens* Wollenw. was also involved. In 1964 it was isolated from cuttings on a nursery in Middx. and by the end of that year it had been recorded on five nurseries in Kent and on one in Surrey. The fungus had not before been recorded in this country and its identity was confirmed by Dr. Booth at C.M.I. Further records from the Wye Sub-Region came in the later years. In 1965 *F. redolens* was found in the Lee Valley and although spreading less quickly than verticillium wilt, it caused considerable losses in crops. The outbreaks in England were often associated with importation of cuttings from countries with warm climates.

Die-back, Stem Rot and Foot Rot (*Fusarium culmorum* (W. G. Smith) Sacc.) are still very common troubles. In the Lee Valley, most attacks were seen in 1963 and 1964, when losses in newly-planted crops were heavy, and in 1968. The adviser commented that infection through the cut ends seemed at a maximum in spring and autumn but reached its lowest level in summer—a pattern which appears to be consistent every season. In the south-east, infection was becoming troublesome in 1963. On occasions, *F. avenaceum* (Fr.) Sacc. has been identified in outbreaks of stem and foot rot.

In the Lee Valley, **Leaf Spot and Stem Rot** (*Alternaria dianthi* Stev. & Hall) (Plate VII, 1) was above average in the 1962/63 winter and during 1968. **Leaf Spot** (*Alternaria dianthicola* Neerg.) severely affected the lower leaves of freshly rooted cuttings in a nursery in Hants early in 1965. Spores typical of this fungus had previously been seen by the author on seed of English origin examined at Harpenden prior to export, but the fungus is not known to have been otherwise recorded in this country. *A. dianthicola* may perhaps be more common in Britain than the records indicate. **Grey Mould** (*Botrytis cinerea* Fr.) was not particularly troublesome but the fungus may perhaps prove a problem in cold-stored cut flowers (Edney, *Ann. appl. Biol*, 1967, **60**, 367-74). Rapid development of mould after cool storage has prompted studies at G.C.R.I. on the microflora of flowers (Gandy, *Rep. Glasshouse Crops Res. Inst. 1966*, 89; *1967*, 88). **Rust** (*Uromyces dianthi* (Pers.) Niessl) was particularly prominent in the Lee Valley in autumn and winter of 1962/63 but the epidemic had subsided by May. Incidence was then low for several seasons (it was unusual to find rust in newly planted crops in 1967) but the disease was again severe on some nurseries in the Valley in 1968 and seemed to be increasing in importance. **Stem Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) occurred in

several areas, affecting young plants in the first few weeks after planting. It became increasingly important in the Lee Valley and was particularly noticeable in 1968. **Bud Rot** (*Fusarium tricinctum* (Corda) Sacc. f. *poae* (Peck) Snyder & Hansen) caused economic loss on a Hants nursery in 1964 and was associated with severe mite (*Siteroptes graminum* syn. *Pediculopsis graminum*) infestation: the trouble was noted in Kent too. *Phomopsis* sp. was associated with **Foot Rot** on a Som nursery (*P. caryophylli* has been found previously on stems of cultivated carnations (Moore, *Br. Parasitic Fungi*, p. 248)).

No more **Slow Wilt** (*Erwinia chrysanthemi* Burkh. *et al.*) (see p. 157) has been seen: but **Bacterial Wilt** (*Pseudomonas caryophylli* (Burkh.) Starr & Burkh.) (see p. 158) reappeared in the Lee Valley in 1965, occurring on three nurseries; the outbreaks were on plants grown from English cuttings supplied from a single source. A species of *Pseudomonas* was isolated at Plant Pathology Laboratory, Harpenden from imported cuttings showing basal rot and decay of the lower leaves especially at the nodes. Although the bacterium may have been a primary pathogen the attack was probably encouraged by rooting the cuttings with the lower leaves under the surface of the rooting medium.

Carnation **Ring Spot** virus was still troublesome in some stocks though it became much less widespread than formerly (Hollings and Stone, *Ann. appl. Biol.* 1965, **56**, 73-86). The less damaging carnation **Mottle** virus is present in most commercial carnations and may be of economic importance because of its prevalence (Hollings and Stone, ibid. 1964, **53**, 103-18). Carnation **Etched Ring** virus seems to occur widely, but carnation **Vein-mottle** virus only occasionally. Carnation **Latent Virus** seems of significance only when present with other viruses, whose effects it increases. The occurrence of **Alfalfa Mosaic** virus has already been mentioned (p. 159). **Streak** (see p. 159) is not often seen in commercial stocks, though it occurs commonly in cv. Orchid Beauty, but in summer 1967 newly-planted crops in the Lee Valley showed typical severe symptoms; yellow and tangerine cultivars were the worst affected, severe yellow streaks usually being present on the lower leaves with leaf tissue discoloured a rusty-brown. Other reports came from the south-east in 1968.

The discrete white circular spots on petals and foliage, indicative of **Low Temperature Injury,** were reported on some nurseries. On certain Lee Valley nurseries where temperatures had reached below freezing, red flowers developed white blotches while white or pale pink flowers developed pink blotches. On a nursery in Hants, **Copper Toxicity** seemed to have severely deformed shoots of certain nodes so that axis growth was turned through 90 degrees. The affected nodes showed severe longitudinal cracking, and cropping was badly affected. **Grassiness** (believed to be a genetical trouble) was noted. Other non-parasitic disorders of this crop, **Calyx Splitting, Hollow Flowers, Petal Curling** or **Sleepiness** and **Curly Tip** are discussed in *A Manual of Carnation Production, Bull. Minist. Agric. Fish. Fd, Lond.* No. 151, 1967. London: H.M.S.O.

Chrysanthemum

Very little **Flower Scorch** (*Itersonilia perplexans* Derx) was seen in 1964,

but in other years the disease appeared in many areas and often contributed to major losses, particularly in late 1968. **Ray Blight** (*Mycosphaerella ligulicola* Baker, Dimock & Davis) (Plate IX, 1) further established itself as an important disease throughout the country, reaching the north of England during the period. It was widely reported in most years but, as with *Itersonilia*, little was seen in 1964. The fungus attacks leaves, stems, buds and flowers and kills the growing point. It has been found attacking the roots only, though accompanying symptoms have been stunting, death of lower leaves and marginal necrosis and interveinal chlorosis of the younger leaves. The perfect stage has been recorded on affected roots. The fungus is capable of attacking plants other than *Chrysanthemum* (Chesters and Blakeman, *Ann. appl. Biol.* 1967, **60**, 385-90). A fungus isolated from stems and from lesions on leaves on plants from I. of Ely resembled this *Mycosphaerella* in all respects except spore size (averaged 17 μm x 4·5 μm).

Phoma Root Rot (*Phoma* sp.) was reported in areas additional to those mentioned on p. 161, and the disease was recognized as a widespread and troublesome problem. **Pythium Stem Rot** (*Pythium* spp.) occurred in several areas each year and was sometimes severe: *P. paroecandrum* Drechsl. was identified on a few occasions. In the Lee Valley this disease was becoming more important in the early years; in 1964 it was above average in Shoesmith and Iceberg cultivars there, and in late 1965 was again a serious problem in Shoesmith cultivars. In contrast only one attack was seen in the Valley in 1967—a very great reduction after the experience of the previous few years. **Root Rot** (*Pythium* sp.) troubles were also quite common during the seven years.

Verticillium Wilt is a major disease and now largely attributed to *Verticillium dahliae* Kleb. In the Lee Valley it increased considerably in A.Y.R. and pot chrysanthemums in 1963 and was prominent there and in some other areas in 1967. On many occasions it was noted that this wilt and phoma root rot were present together.

White Rust (*Puccinia horiana* Henn.) was unknown in Europe before 1963, but in that year was discovered on a nursery in Essex on stock originally imported from Japan. Eradication measures were taken but the disease appeared on over 50 nurseries or gardens, mainly in south-west England, between mid-October 1965 and mid-January 1966. However, only one of the outbreaks (in the Lee Valley) was in a main chrysanthemum-growing area. The attempt at eradication went on, but between August 1966 and mid-January 1967, nine further outbreaks, including one in Wales, and two recurrences, were reported. Since then the rust has been seen only in a garden in Wilts (Oct. 1967) and on a nursery in Som (Jan. 1969) and there is still no evidence that the disease has established itself in this country. A detailed account of the outbreaks from 1963-66 has been given by the present author (*Pl. Path.* 1967, **16**, 162-6). The introduction of the disease on to the Continent of Europe was unconnected with that into England (*loc. cit.*). Knowledge gained about the disease (Firman and Martin, *Ann. appl. Biol.* 1968, **62**, 429-42; Dickens, *Pl. Path.* 1968, **17**, 19-22) since it reached this country will be valuable if the rust ever becomes established. The long-established **Rust** (*Puccinia chrysanthemi* Roze) was apparently of little general significance during the period. **Blotch** (*Septoria chrysanthemella* Sacc. and *S. obesa*. Syd.) was regularly noted and occasionally troublesome.

S. obesa (see p. 162) was fairly commonly identified in the Wye Sub-Region and the Eastern Region, and other reports came from the south-west, the Midlands and the Yorks and Lancs Region. A species of *Septoria* with spores indistinguishable from those of *S. leucanthemi* Sacc. & Speg. was seen on A.Y.R. cultivars on a Devon nursery in 1968. **Grey Mould** (*Botrytis cinerea* Fr.) is an important cause of loss but no year was particularly outstanding. *Botrytis* frequently reduces quality and quantity in production of cuttings rooted in mist-propagation benches following cold storage; and intensive production methods also favour infection (Smith and Evans, *Pl. Path.* 1967, **16**, 157-9). **Powdery Mildew** (*Oidium chrysanthemi* Rabenh.) was a fairly common trouble.

Stem Rot (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was above average in the Lee Valley in 1963 and by 1964 seemed to be an increasing problem in the A.Y.R. crop there: severe attacks occurred in the Valley in 1967 too. *Rhizoctonia* sp. was reported to be affecting lower leaves of cv. Golden Princess Anne in Surrey in 1966. *Phytophthora* species including *P. cryptogea* Pethybr. & Laff. are known to cause **Root Rot** and related troubles in chrysanthemums. In 1963 *P. porri* Foister caused extensive **Damping-off** and **Stem Rot** in propagating beds containing Fred Shoesmith and other cultivars in the east Midlands. It appeared to be the first record of the fungus, whose identity was confirmed by Miss G. Waterhouse, on this host. On a few occasions, *Phytophthora* has been isolated from leaves bearing blotches and in one instance the species resembled *P. cinnamomi* Rands. *Fusarium* sp. caused **Root Rot, Foot Rot** or **Wilt** on occasions, and one outbreak of foot rot was attributed to *F. culmorum* (W. G. Smith) Sacc. A few outbreaks of root rot in Wales have involved *Cylindrocarpon* sp., sometimes identified as *Nectria radicicola* Gerlach & Nilsson syn. *C. destructans* (Zins.) Scholten. **Sclerotinia Rot** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was sometimes troublesome and a report of **Wilt,** in Caerns in 1967, involved *S. minor* Jagger.

Flower Spotting (*Alternaria* sp.), first noted on p. 162, was present on cv. Snow Dance in 1964 in Surrey. Outdoor chrysanthemums, Snow Dance and Bessie Rowe were affected in Devon the same year. *Alternaria* sp. affected leaves of many outdoor plants in a plot of cv. Vibrant in Sussex in 1967. **Sooty Mould** (*Cladosporium herbarum* (Pers.) S. F. Gray) occurred on petal tips in a crop in Cornwall in 1965 and was probably colonizing honey-dew from aphids. *Plicaria fulva* R. Schneider smothered chrysanthemum cuttings in cardboard boxes in a Som nursery in 1963: the white powdery growth occurred on petioles, the undersides of leaves and, slightly, on the boxes. The perfect stage was abundant on the compost.

Bacterial Wilt (*Erwinia chrysanthemi* Burkh. *et. al.*) has been confirmed on a few occasions on chrysanthemums grown in this country. *Erwinia* sp. was isolated from collapsed plants showing **Stem Rot** in Sussex in 1967. Bacteria were again implicated in **Bud Rot, Flower Rot** and various types of **Stem Rot** (see p. 164) and where identifications were made *Pseudomonas* sp. was found to be involved. *Ps. marginalis* (Brown) Stevens was identified in one extensive attack on flowers and in a severe outbreak of leaf scorch involving marginal and interveinal necrosis outdoors. *Pseudomonas* sp. was implicated in leaf spotting in another instance.

The decline of **Flower Distortion** (tomato aspermy virus) mentioned in

respect of the later years of the 1957-61 period (p. 164) was followed by an increase in many areas in several seasons following, and by 1966 and 1967 it was still a major problem in some areas, but little comment on the disease was received in 1968. **Stunt** (chrysanthemum stunt virus) was above average in the Lee Valley late in 1964 but at a strikingly low level the following season. It was a problem in several nurseries. **American Stunt** (strain of chrysanthemum stunt virus) and **Green Flower** (chrysanthemum green flower virus) occurred in some stocks and **Dwarf Mottle** (virus complex) was seen in quite a few. **Arabis Mosaic** and **Alfalfa Mosaic** viruses were confirmed in rare instances. A virus serologically related to sowbane mosaic and carnation 689 viruses apparently occurs commonly in commercial cultivars (Boutell, *Rep. Glasshouse Crops Res. Inst. 1966*, 94). Other viruses in this crop are referred to in Part I.

Many non-parasitic troubles were reported. **Crumpled Petal** (Plate VIII, 1, 2) in Balcombe cultivars was particularly severe at the end of 1966 in the Lee Valley. In 1964 a **Leaf Spot** condition in Silversmith was apparent on most nurseries growing this cultivar in the Wye Sub-Region, and developed on Silversmith on two other nurseries in the South-eastern Region. Black or purple-brown necrotic spots occurred on the leaves and were believed to be genetic in origin. Necrosis of the flower buds and bracts and a scorch of the growing point and upper leaves were sometimes associated symptoms. On a Bucks nursery the condition had been seen in previous years. **Rosetting, Fasciation,** various flowering abnormalities and a range of injuries by fungicides, pesticides and weedkillers were among other troubles.

DISEASES OF OTHER ORNAMENTAL AND MISCELLANEOUS PLANTS

ACACIA A newly recorded host for **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

ACANTHUS A **Powdery Mildew** (*Oidium* sp.) was noted (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 6).

ACER see Maple.

ACHIMINES The physiological **Ring Pattern,** familiar in the Gesneraceae and attributed to sudden chilling of the leaves by overhead watering in sunlight (Hollings, *Pl. Path.* 1955, **4**, 123-8) developed on a nursery in Glam.

AGAVE The **Leaf Spot** (*Coniothyrium concentricum* (Desm.) Sacc.) recorded on yucca (p. 204) was found on agave.

AILANTHUS A further host for **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

AJUGA **Arabis Mosaic** and **Cucumber Mosaic** viruses have been isolated (Hollings and Stone, *Rep. Glasshouse Crops Res. Inst. 1964*, 96).

ALDER *Leptothyrium alneum* Sacc. (see Grove, *Br. Coelomycetes*, **2**, p. 169 and Peace, *Pathology of Trees and Shrubs*, p. 473) was noted in Kent as associated with a marginal leaf scorch.

ALMOND (Flowering) see Prunus.

ALOE **Rust** (*Uromyces aloes* (Cooke) Magn.), which was seen earlier on imported aloes (Moore, *Br. Parasitic Fungi*, p. 400) was found, in Wilts in 1962, on plants imported from Africa (Brooks, *Jl R. hort. Soc.* 1966, **91**, pp. 5-6).

ALSTROEMERIA **Violet Root Rot** (*Helicobasidium purpureum* Pat.) (see p. 167) was again recorded, this time in Glos, and *Botrytis* sp. caused general flower spotting in a Cornish Crop. **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was reported, and *Rhizoctonia* and *Colletotrichum* sp. were both associated with collapse of plants in one crop.

ALTERNANTHERA On a nursery in Hants, blackening of the main stem and death of rosettes was apparently associated with *Phoma eupyrena* Sacc.; the identity of the fungus was confirmed at C.M.I., Kew.

ALYSSUM In several instances **Downy Mildew** was attributed to *Peronospora parasitica* (Fr.) Fr. (see also p. 167). **Club Root** (*Plasmodiophora brassicae* Woron.) and **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) were reported, and *Phytophthora* amd *Rhizoctonia* were again associated with losses. In a crop in Carms in 1968, **Leaf Spot** affected cotyledons and first-leaves and the plants were eventually stunted: the disease, which was seed-borne, was attributed to *Alternaria alternata* (Fr.) Keissler (syn. *A. tenuis*) (Humphreys-Jones, *Pl. Path.* 1969, **18**, 96). *Alternaria* also caused leaf spotting in Kent, and these records appeared to be new for this host.

AMARYLLIS In Anglesey, a severe infection of roots and scales of potted plants was attributed to *Rhizoctonia* sp. in addition to *Stagonospora curtisii* (Berk.) Sacc. Symptoms caused by tomato **Spotted Wilt** virus were noted.

ANCHUSA **Verticillium Wilt** (*Verticillium dahliae* Kleb.) caused yellowing of leaves and discoloration of the vascular tissue in the crown of plants on a site in the west Midlands.

ANEMONE **Grey Mould** (*Botrytis cinerea* Fr.) and **Downy Mildew** (*Peronospora ficariae* Tul.) remained major problems. The other downy mildew (*Plasmopara pygmaea* (Ung.) Schroet.) was again noticed in Cornwall. In Part I (p. 168) reference was made to the possible role of *Itersonilia perplexans* Derx in **Petal Blight** in the south-west. In winter 1961/62 this fungus was identified in several crops in Devon and Cornwall and its effects were sometimes severe. Miss M. E. Parry reported successful inoculation to chrysanthemums and re-isolation. Further attacks were seen there in the next few seasons and it became apparent that the disease was very common in these counties and often epidemic in late autumn. **Petiole Rot** (see p. 168), caused variously by *Phytophthora* sp. and *Pythium* sp., appeared again in the south-west. A species of *Centrospora* was isolated from roots of dying plants in three crops in this area in 1964.

When leaf samples from Devon and Cornwall were tested by J. E. E. Jenkins and Miss C. A. Leadbeater during 1963-4, 15 of 23 crops were infected with viruses: **Cucumber Mosaic** was most commonly detected, often together with **Anemone Mosaic** (strain of turnip mosaic virus), and also confirmed were **Tobacco Necrosis** and **Arabis Mosaic.** Symptoms were mostly stunting, and yellowing of the foliage, sometimes with twisting and distortion. Flowers were mainly of poor size and colour, often with green streaks and colour breaking. A strain of tobacco ring spot virus had been isolated in 1957 from severely necrosed *A. coronaria* plants from Som and the disease was named **Anemone Necrosis** (Hollings, *Ann. appl. Biol.* 1965, **55**, 447-57).

ANTIRRHINUM **Leaf Spot and Stem Rot** (*Phyllosticta antirrhini* Syd.) (Plate X, 1) has been important, but **Rust** (*Puccinia antirrhini* Diet. & Holw.) had declined in significance with the growing of rust-resistant selections and received little attention. *Alternaria alternata* (Fr.) Keissler was associated with lesions on the growing points and the edges of leaves of seedlings on a Devon nursery in 1967 and proved to be pathogenic (Melville and Chalk, *Pl. Path.* 1968, **17**, 95): this was a newly recorded role for the fungus. Leaves were also affected by *Alternaria* in a Kent crop. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.), **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) and **Stem Rot** (*Botrytis cinerea* Fr.) were other reported troubles.

A new bacterial **Leaf Spot** was first noticed in 1965: it was found on five nurseries in Essex and on seven others scattered in Bucks, Hants and Middx, and it caused substantial losses. The outbreaks in the south-east developed soon after locally very heavy rain in early May. The spots were light brown and their margins red or purple. Whole leaves were killed, and also shoots following spread down the petioles into the stem. The bacterium has been identified as *Pseudomonas syringae* van Hall (syn. *Ps. antirrhini* Takimoto). In the next three years, attacks, quite often severe, developed in the same and other south-eastern counties, and also in the south-west, Herts, Beds, Cambs, Worcs and War. In Cambs, *Ps. marginalis* (Brown) Stevens was isolated from seedlings. Distortion of leaves of seedlings and of young plants on a nursery in Glos was attributable to **Leafy**

Gall (*Corynebacterium fascians* (Tilford) Dowson); axillary buds had tended to grow.

ARBUTUS Records of **Leaf Spot** (*Septoria unedonis* Rob. & Desm.) were received.

ARUM LILY **Root Rot** attacks were variously attributed to the not uncommon *Phytophthora richardiae* Buism. and to *Pythium* sp. and *Rhizoctonia* sp.; *Pythium* was isolated from rotting corms too. **Corm Rot,** associated with *Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye, was not uncommon. **Green Flowers** in one instance were believed to be due to cold temperatures at flower initiation.

ASH **Canker** (*Nectria galligena* Bres.) and **Leaf Spot** (*Septoria fraxini* Desm.) were reported.

ASTER (*Callistephus*) There were further reports, from Wales, of *Alternaria alternata* (Fr.) Keissler (see p. 170) attacking seedlings. Both **Cucumber Mosaic** and tomato **Aspermy** viruses were confirmed in a crop in War in which many flowers were distorted.

AUCUBA *Pythium* sp. caused a severe **Root Rot.**

AURICULA **Cucumber Mosaic** virus was confirmed in plants showing interveinal chlorosis and a tendency to ring pattern, distortion and hooding.

AZALEA see Rhododendron.

BALLOTA Specimens of *Ballota pseudodistamnum* were found to be attacked at the roots by *Armillaria mellea* (Fr.) Kummer (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 4).

BALSAM Various root troubles in seedlings, cuttings or plants were associated with *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., or unidentified species of *Pythium*, *Fusarium* and *Phoma*.

BARBERRY **Verticillium Wilt** (*Verticillium dahliae* Kleb.), **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) and **Cereal Black Rust** (*Puccinia graminis* Pers.) were mentioned in reports.

BAY Of interest on *Laurus nobilis* were **Powdery Mildew** (*Oidium* sp.) at Bristol, and **Leaf Spot** caused by *Phyllosticta lauri* Westend. in a garden in Cards and by a fungus resembling *Gloeosporium nobile* Sacc. in Merioneth. *G. nobile* had not previously been reported in this country. *Armillaria mellea* (Fr.) Kummer was found on bay with rotting roots.

BEECH T. F. Preece (pers. comm.) reported a remarkable development of **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) in a 15-year old hedge near Leeds: many bushes, green and alive in spring, bore copiously sporulating spots later in the year. Also noted by advisers was the common **Heart Rot** (*Ganoderma applanatum* (Wallr.) Pat.).

BEGONIA **Powdery Mildew** (*Oidium begoniae* Oudem.) is the major trouble. *Pythium* sp. was held responsible for several **Root Rot** attacks in plants and cuttings: *P. ultimum* Trow was confirmed on new imports. *Botrytis cinerea* Fr. was responsible for **Stem Rot** and was noted affecting foliage, and a report of **Verticillium Wilt** (*Verticillium* sp.) was of interest. In the south-west in 1968, **Tuber Rot** in cv. A. J. Bard was attributed to *Nectria radicicola* Gerlach & Nilsson syn. *Cylindrocarpon destructans* (Zins.) Scholten; red-brown necrotic areas were apparent in the flesh, and the activity and vigour of sprouts were affected. When isolates of the fungus were inoculated into healthy tubers at the N.A.A.S. Regional H.Q., Bristol, a similar, though more yellowish rot was induced.

BERGENIA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted.

BIRCH **Leaf Rust** (*Melampsoridium betulinum* (Fr.) Kleb.) affected nursery stocks of silver birch, and *Armillaria mellea* (Fr.) Kummer was again recorded affecting birch.

BLUEBELL **Rust** (*Uromyces muscari* (Duby) Lév.) was reported and **Tobacco Rattle** virus has been isolated (Hollings *et al.*, *Rep. Glasshouse Crops Res. Inst. 1965*, 103).

BOX **Leaf Spot** (*Mycosphaerella limbalis* (Pers.) Arx) was found in 1966 in Devon (Pirozynski and Morgan-Jones, *Trans. Br. mycol. Soc.* 1968, **51**, 198); the imperfect stage, *Phyllosticta limbalis* Pers., has been seen in England before (Grove, *Br. Coelomycetes*, **1**, p. 10). Another leaf spot (*Phyllosticta buxina* Sacc.), rarely noted, was found in Som. Box was newly recorded for this country as an **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) host.

BROOM A **Powdery Mildew** (*Oidium* sp.) was recorded on *Cytisus* (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 6). Further attacks of **Die-back** (*Pleiochaeta setosa* (Kirchn.) Hughes) and of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were observed.

BUCKWHEAT In 1964 a black **Stem Rot** (*Fusarium avenaceum* (Fr.) Sacc.) was reported by T. F. Preece in a number of plants in boxes at Leeds. Several hundreds of seedlings were affected at soil level and completely collapsed. Preece (pers. comm.) reported that buckwheat plants were successfully infected with an isolate of the fungus and the symptoms reproduced. The identity of the fungus was confirmed at C.M.I., and this was believed to be a new record of *F. avenaceum* on this host.

CABBAGE (Ornamental) **Turnip Crinkle** virus has been isolated from leaves of ornamental variegated cabbage (*Brassica oleracea* var. *capitata*) in Southern England (Hollings and Stone, *Rep. Glasshouse Crops Res. Inst. 1962*, 118-25).

CACTUS *Pythium* sp. was thought to be responsible for a severe rot of opuntias in Sussex, and *Fusarium* sp. had apparently caused a dark grey to black dry rot of segment bases of a cactus plant in Cards. There is evidence of virus infection in opuntia (Hollings *et al.*, *Rep. Glasshouse Crops Res. Inst. 1966*, 102).

CALCEOLARIA *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. caused **Foot Rot;** and *Botrytis* sp. was noted as damaging.

CALLUNA **Root Rot** (*Phytophthora cinnamomi* Rands) was confirmed in several cultivars in Sussex, and unidentified species of *Pythium* and *Phytophthora* affected the roots of a number of cultivars on a nursery in Hants. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. had apparently killed numerous plants on a nursery in Herts: lower leaves had yellowed and the roots decayed. **Stem Rot** (*Phytophthora* sp.) occurred several times in the south-east.

CAMELLIA *Glomerella cingulata* (Stonem.) Spauld. & Schrenk was associated with **Die-back** in Dorset. In 1962, Peace (*Pathology of Trees and Shrubs*, p. 493) mentioned that the fungus had not been found in Britain on camellias. Further records of **Gall** (*Exobasidium camelliae* Shirai) (see p. 172) came from Devon in 1962 and 1963 and from Cornwall in 1967 (Reid, *Trans. Br. mycol. Soc.* 1969, **52**, pp. 19-20). *Pythium* sp. and

Armillaria mellea (Fr.) Kummer both caused **Root Rot. Oedema** (non-parasitic) is sometimes encountered.

CAMPANULA Sooty spots, up to 1 cm or more in diameter, with necrosed centres occurred on both white and blue cultivars of *Campanula isophylla* in the Yorks and Lancs Region in 1966. Spores of *Stemphylium* sp. were consistently found, and inoculations by the Regional plant pathologists produced infections. The fairly common **Leaf Spot** (*Ramularia macrospora* Fresen.) and **Wire Stem** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) were both noted.

CARPINUS *Taphrina carpini* (Rostr.) Johans. was recorded at Kew Gardens (Reid, *Trans. Br. mycol. Soc.* 1969, **52**, pp. 29-30).

CEDAR *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was troublesome in frames on a Surrey nursery.

CELOSIA **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was recorded (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 5).

CHAMAECYPARIS **Stem and Root Rot** was encountered several times in Surrey in 1967 and 1968; plants of several varieties were eventually killed. The causal fungus, newly recorded on this host (Evans, *Pl. Path.* 1968, **17**, 143-4), was *Phytophthora cinnamomi* Rands. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was reported on Lawson cypress.

CHAMOMILE *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was associated with **Root Rot.**

CHERRY (Flowering) see Prunus.

CHERRY LAUREL see Prunus.

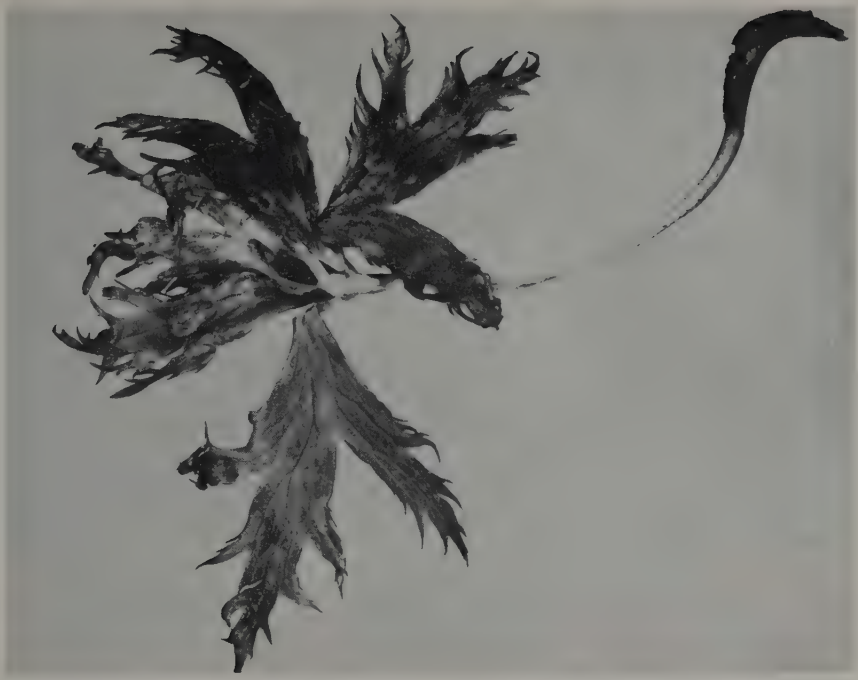
CHESTNUT (*Castanea*) **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was confirmed in seedlings and in 2-5 year old sweet chestnut trees in Surrey Growth was unthrifty.

CHLOROPHYTUM *Pythium* sp. caused a **Root Rot.**

CHOISYA *Phomopsis choisyae* Grove had been recorded earlier on old dead stumps of *Choisya ternata* at one or two sites (Grove, *Br. Coelomycetes*, **1**, pp. 172-3). In 1968 this fungus was associated with cankers on the petioles of *C. ternata* in Merioneth, and dying and leaf fall were said to result.

CHRYSANTHEMUM (For florists' chrysanthemum see p. 270) **Leaf Blotch** (*Septoria* sp.) was noted on *Chrysanthemum maximum*. According to Punithalingam and Wheeler (*Trans. Br. mycol. Soc.* 1965, **48**, 423-39) the only *Septoria* known on *C. maximum* appears to be identical morphologically with *S. leucanthemi* Sacc. & Speg.

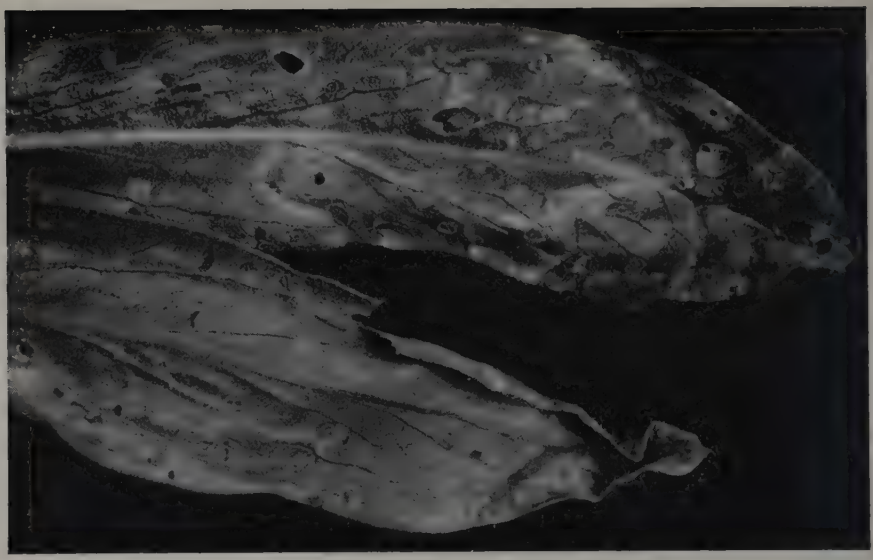
CINERARIA Most common was **Powdery Mildew** (*Sphaerotheca fuliginea* (Schlecht.) Salm.), while **Root and Stem Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was occasionally troublesome. **Downy Mildew** (*Bremia lactucae* Regel) was noted once again. The **Rust** (*Puccinia lagenophorae* Cooke syn. *P. terrieriana* Mayor) which was first reported in this country on groundsel in 1961, and very quickly spread on this weed (Wilson *et al.*, *Trans. Br. mycol. Soc.* 1965, **48**, 501-11), extensively damaged cinerarias on a nursery in Flints in 1964 and appeared later on a few nurseries in the south-west. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was recorded (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 5). *Fusarium* sp. (see p. 173) was again associated with wilt or stem rot in this host; and **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) affected a batch of plants in Notts.



1. Globe flower (*Trollius*) leaf affected by smut (*Urocystis anemones*) (p. 283). The petiole is also affected.

2. Laburnam leaves with symptoms of laburnam mosaic virus (p. 184).

PLATE XV



1. Scabious leaves affected by leaf spot (*Ascochyta scabiosae*) (pp. 196, 298) and showing necrosed leaf tips.

2. Dahlia leaf bearing lesions of smut (*Entyloma dahliae*) (p. 174).

PLATE XVI

CISSUS The appearance of **Powdery Mildew** (*Oidium* sp.) on *Cissus antarctica* in the Lee Valley in 1962 was interesting, and the fungus was again seen in the Valley in 1967: the conidia measured 26 - 31 x 16 - 11 μm. *Rhizoctonia* sp. was associated with an outbreak of **Root Rot** in Kent.

CITRUS (*Glomerella cingulata* (Stonem.) Spauld. & Schrenk was identified on specimens showing **Leaf Spot** in Hants in 1968.

CLARKIA *Rhizoctonia* sp. caused **Root Rot** on a Berks nursery.

CLEMATIS *Pythium* sp. and *Phytophthora* sp. were involved in an outbreak of **Root Rot** but conditions were poor and the plants overwatered. **Stem Rot** (*Botrytis cinerea* Fr.) was implicated in the death of recently propagated plants on two premises.

COCKSCOMB *Gibberella baccata* (Wallr.) Sacc. was considered to be killing plants on a nursery in Leics in 1968, the *Fusarium lateritium* Fr. stage being present. I. F. Storey reported the following symptoms: The large dark necrotic lesions had well-defined irregular margins, and the older lesions tended to show zonation associated with the sporodochia; sporulation occurred all along the stem and plants were quickly killed. In flowering plants the condition resembled fusarium wilt of china aster. There was a report of **Root Rot** caused by a species of *Pythium*.

COLEUS An unidentified *Verticillium* caused **Verticillium Wilt** in Devon in 1963: a similar condition had been noted in 1938 in Som. Other isolated troubles were **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.), **Black Leg** (*Pythium* sp.) and **Wilt** (*Fusarium* sp.). With the latter, young plants in Caerns were killed and inoculation tests with *Fusarium* proved it to be pathogenic.

COLLINIA Basal lesions on potted palms (*Collinia elegans*) in the Lee Valley in 1967 were apparently caused by *Nectria* sp. A species of *Gliocladium*, thought to be the imperfect stage of the *Nectria* was present too. Both genera were confirmed at C.M.I., Kew.

CORNFLOWER **Flower Scorch** (*Itersonilia perplexans* Derx) affected all open blooms in a 4-acre crop in Surrey in 1964. The disease was noted again the following year. **Downy Mildew** (*Bremia lactucae* Regel), rare on this host, caused moderate infection at a site in Beds.

CORNUS Plants dying in plastic containers in Hants had **Root Rot** (*Pythium* sp.).

COTINUS **Powdery Mildew** (*Oidium* sp.) was observed (Green and Brooks *Jl R. hort. Soc.* 1964, **89**, pp. 127-9) on specimens of smoke bush (*Cotinus coggyria* syn. *Rhus cotinus*) from Devon in 1963, and no other reference to mildew on this host was traced.

COTONEASTER **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was found on *Cotoneaster franchettii* in Herts. *Nectria cinnabarina* (Fr.) Fr. and *Botrytis cinerea* Fr. were variously associated with **Die-back** outbreaks, and the latter fungus was involved also in failure of cuttings. **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) continued to spread in the south-east and east of the country and occurred in further species of *Cotoneaster* (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2). **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) affected several plants of *C. salicifolia*.

CRAMBE Decay of *Crambe maritima* plants in Essex was consistently associated with *Fusarium* sp.

CRASSULA **Stem Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was noted.

CRINUM Plants of *Crinum* x *powelii* were severely affected by **Leaf Scorch** (*Stagonospora curtisii* (Berk.) Sacc.) in Surrey in 1966 (Brooks, *Jl R. hort. Soc.* 1966, **91**, p. 498).

CROCUS **Grey Bulb Rot** (*Sclerotium tuliparum* Kleb.) which has only been seen on crocus once or twice previously, was confirmed in a garden in Cambs. **Grey Mould** (*Botrytis cinerea* Fr.) damaged shoots of plants in wet cold conditions, and **Fusarium Rot** (*Fusarium oxysporum* Fr.) was noted in pot plants. **Tobacco Rattle** virus has been found in crocus (Hollings *et al.*, *Rep. Glasshouse Crops Res. Inst. 1965*, 103; Hollings, ibid. *1967*, 108).

CROTON Outbreaks of **Root Rot** in *Croton pictum* were associated with *Thielaviopsis basicola* (Berk. & Br.) Ferr. and *Pythium* sp.

CURRANT (Flowering) **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was reported.

CYCLAMEN The most common problem was **Grey Mould** (*Botrytis cinerea* Fr.). **Corm and Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) appeared occasionally, sometimes associated with some probably predisposing factor: this fungus also caused petioles of seedlings to rot on a Lee Valley nursery. Other rots were associated with *Phytophthora* sp. and *Thielaviopsis basicola* (Berk. & Br.) Ferr. Environmental conditions seemed likely factors when **Fusarium Wilt** (*Fusarium* sp.) attacked one batch of plants. **Leaf Spot** (*Alternaria* sp.) was prevalent on a nursery in War in 1967. **Soft Rot** (*Erwinia carotovora* (Jones) Bergey *et al.* var. *carotovora* Dye) of corms or plants was another trouble in this host.

CYDONIA **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) was recorded on *Cydonia oblonga* (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

CYMBIDIUM **Leaf Spot** (*Colletotrichum orchidearum* Allesch.) was identified on plants dying-back in Kent. **Damping-off** of seedlings in Devon was consistently associated with *Rhizoctonia* sp., although cultural factors were probably a main factor. *Pythium* sp. caused **Root Rot.** Cymbidium **Ring Spot** virus has been newly described (Hollings and Stone, *Rep. Glasshouse Crops Res. Inst. 1962*, 90; *Ann. appl. Biol.* 1965, **56**, 87-98).

CYPRESS (Cupressus) **Root Rot** in plants with yellowed foliage was associated with *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) and *Pythium* sp.; and death of cuttings in one instance with *Cylindrocarpon* sp. Cuttings on a nursery in Cards rooted poorly in competition for nutrients with *Plicaria fulva* R. Schneider: this fungus had colonized the peat-sand compost and was sporing profusely on the beds.

CYPRIPEDIUM *Botrytis* sp. was responsible for a rot of flowering buds while in the axils, causing concern on a nursery in Berks. **Leaf Spot** (*Colletotrichum* sp.) was noted in Sussex.

DAHLIA A devastating attack of **Flower Scorch** (*Itersonilia perplexans* Derx) occurred in several cultivars on a Surrey nursery. *Verticillium dahliae* Kleb. was identified in two outbreaks of **Verticillium Wilt** in the north, and the rather uncommon **Leaf Spot** (*Ascochyta dahliicola* (Brun.) Petr.) was mentioned in reports. Cuttings were occasionally attacked by *Pythium* sp. A virus, previously unrecognized in Britain, **Tobacco Streak,** was

isolated from dahlias in 1966 (Brunt, *Pl. Path.* 1968, **17**, 119-22): its significance here was unknown but it was thought to be less damaging than other viruses occurring in dahlias.

DAPHNE *Botrytis* sp. killed a *Daphne mezereum* bush, following dying-back, in Oxon.

DELPHINIUM The record of **Verticillium Wilt** on p. 175 was thought to be new for the host in this country. In that instance *Verticillium dahliae* was involved: since then, *V. alboatrum* Reinke & Berth. has also been recorded as a cause of wilt in delphiniums. **Flower Scorch** (*Itersonilia* sp.) was identified when prematurely fading blooms were examined in Surrey. **Stem Canker and Wilt** (*Fusarium oxysporum* Fr.) attacked larkspurs on a nursery in War in 1965 (Ryan, *Pl. Path.* 1966, **15**, 96): it had apparently not been recorded in this country previously. The spores agreed closely in size with those of *F. oxysporum* Fr. f. *delphinii* Laskaris which occurs in the U.S.A. **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) also occurred on larkspur; and *Pseudomonas marginalis* (Brown) Stevens was isolated from stunted larkspurs in which the vascular tissue was stained brown and the lower leaves were yellow and, in another instance, was isolated from wet, black, rotting buds. Both bacterial attacks occurred in the Eastern Region. **Delphinium Yellows** virus was confirmed in a delphinium from a Kent garden (Posnette and Ellenberger, *Ann. appl. Biol.* 1963, **51**, 69-83).

DIANTHUS (For florists' carnation (see p. 269) the not uncommon disease **Fusarium Wilt** was diagnosed on several nurseries and attributed mostly to *Fusarium oxysporum* Fr. f. *dianthi* (Prill. & Delacr.) Snyder & Hansen, though on one occasion in Devon *F. redolens* Wollenw. was the invader. **Verticillium Wilt** (*Verticillium* sp.) killed many plants on a nursery in Devon. Various **Foot Rot** and **Damping-off** troubles were caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.

DICHOTOMANTHES **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) has been found on *Dichotomanthes tristaniaecarpa* (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

DRACAENA Severe decay of leaves, particularly of senescent foliage, of *Dracaena sanderiana* occurred in the Lee Valley, and a fungus agreeing fairly closely with *Macrophoma draconis* Allesch. was isolated. *Fusarium oxysporum* Fr. and *Pythium* sp. were isolated from rotting roots of *D. terminalis* in the Lee Valley, only the cortical cells being affected.

ECHINOPS **Cucumber Mosaic** virus had caused reduction of the leaf lamina and some distortion in plants examined in Berks.

ELAEAGNUS A dozen shrubs of *Elaeagnus variegata* were extensively affected with **Leaf Spot** (*Phyllosticta argyrea* Speg.) in Kent.

ELDERBERRY **Strawberry Latent Ring Spot** virus was confirmed in material from Ches (Lister, *Ann. appl. Biol.* 1964, **54**, 167-76).

ELM **Dutch Elm Disease** (*Ceratocystis ulmi* (Buisman) Moreau) was reported more frequently in the later years and was causing concern.

EMBOTHRIUM An outbreak of **Root Rot** in Hants was attributed to *Rhizoctonia* sp. and *Pythium* sp.

ERANTHIS The widely distributed **Smut** (*Urocystis eranthidis* (Passer.) Ainsw. & Samps.) of winter aconite was again recorded.

ERICA **Crown Rot** (*Phytophthora cactorum* (Leb. & Cohn) Schroet.) caused

extensive losses on a nursery. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., *Botrytis cinerea* Fr. and *Pestalotia* sp. induced the odd trouble in propagation beds.

ESCALLONIA Another new host for **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

EUCALYPTUS A few more reports were received of **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.), which has only recently been recorded on this host (p. 176). *Botrytis* sp. caused severe **Stem Rot** in pot-grown plants on a nursery in Hants, and **Oedema** (non-parasitic) was noted on *Eucalyptus glaucens* in Pemb.

EUONYMUS Reports of **Powdery Mildew** (*Oidium euonymi-japonicae* (Arcang.) Sacc.) were plentiful. **Leaf Spot** (*Septoria euonymi* Rabenh.), seldom recorded in the past, appeared in Cards, and also noted were **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

EUPHORBIA *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. caused **Damping-off** and **Basal Rot** in *Euphorbia fulgens* in Sussex.

EXOCHORDA A record of **Verticillium Wilt** (*Verticillium dahliae* Kleb.) from Oxon appeared to be the first for this genus.

FATSHEDERA *Pythium* sp. was found in the roots of defoliating plants.

FATSIA. Fatsia was added to the list of hosts of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer).

FERN *Phoma* sp. attacked *Pteris cretica* on a nursery in Lancs in 1966 (Alonso, *Pl. Path.* 1968, **17**, 191-2). Symptoms were a progressive necrosis of the veins, light-brown necrosed areas at the tips and margins of leaves, browning of petioles and some root rot. **Grey Mould** (*Botrytis cinerea* Fr.) had affected maidenhair fern in Merioneth. Virus-like symptoms had been seen occasionally but it was not until recently (Hull, *Virology*, 1968, **35**, 333-5) that a virus was confirmed in ferns: it was isolated from hart's-tongue fern (*Phyllitis scolopendrium*) from Cornwall and from other specimens from Cambridge University Botanic Garden; and rod-shaped particles were found in several other genera in the fern collection in Cambridge.

FILIPENDULA **Leaf Spot** (*Ramularia spiraeae arunci* (Sacc.) Allesch.) was identified, apparently for the first time in this country, in Norfolk in 1968: the plants were *Filipendula digitata*.

FORSYTHIA **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) was noted in Berks and Hants. **Die-back** of 75 per cent of a large plantation in Kent was caused by *Pseudomonas syringae* van Hall. Plants of *Forsythia spectabilis* with mosaic symptoms contained **Arabis Mosaic** virus (Hollings *et al.*, *Rep. Glasshouse Crops Res. Inst. 1965*, 103).

FOXGLOVE Although recorded on wild foxgloves, **Downy Mildew** (*Peronospora digitalidis* Gaumann) was not reported on cultivated foxgloves until 1967 when E. R. Wallace confirmed it on a nursery in Suffolk.

FREESIA **Hard Rot** (*Septoria gladioli* Passer.) and **Root Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) were recorded. *Fusarium moniliforme* Sheldon the imperfect state of *Gibberella fujikuroi* (Saw.) Ito ap. Ito & Kimura) is commonly associated with damaged freesias and is seed-borne (Smith, *Rep. Glasshouse Crops Res. Inst. 1967*, 90). A newly recognized virus, **Freesia Streak,** occurred commonly in some freesia stocks in 1967 and 1968 (Brunt, ibid. *1967*, 101; *1968*, 104-5).

FUCHSIA *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was associated with rooting failure in cuttings under mist propagation in Glos and was isolated from lesions on stems and petioles of plants in Norfolk. **Root Rot** (*Pythium* sp.) was confirmed in Sussex and **Cucumber Mosaic** virus in Middx.

GAILLARDIA **Smut** (*Entyloma compositarum* Farl.) was found for the first time in this country in 1965 (Shipton, *Pl. Path.* 1967, **16**, 143-4) when plants of *Gaillardia aristata* were affected on a nursery in Berks. In 1966 the disease was again present on this nursery, and in 1967 and 1968 was found on cvs. Croftway Yellow and Ipswich Beauty on the nursery in Norfolk referred to by Shipton (*loc. cit.*). The cultivar Wirral Flame was free from smut in Norfolk as well as in Berks.

GAZANIA **Damping-off** of young plants in Kent was caused by *Pythium* sp.

GENTIAN A further report of **Leaf Blight** (*Pycnothyrium gentianicola* Grove) (see p. 177) came from Cornwall where the disease had apparently killed a lot of the foliage at one site. **Stem Blight** (*Macrophoma* sp.), previously recorded in Scotland (Moore, *Br. Parasitic Fungi*, p. 198) was found in Yorks N.R.

GERANIUM see Pelargonium.

GERBERA There were more reports of **Crown Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.). Tomato **Aspermy** virus was confirmed in Hants.

GLADIOLUS The major fungal diseases were **Fusarium Yellows and Fusarium Rot** (*Fusarium oxysporum* Fr. f. *gladioli* (Massey) Snyder & Hansen) and **Botrytis Rot and Core Rot** (*Sclerotinia draytonii* Buddin & Wakef. and *B. cinerea* Fr.) both of which are important causes of corm loss. The **Rust** *Uromyces transversalis* (Thüm.) Wint. has never been recorded in plants grown in Britain, in fact it has been for long unknown in Europe. Consignments of cut flowers imported from South Africa and bearing uredosori of this rust were intercepted by plant health inspectors and the rust was identified at Plant Pathology Laboratory, Harpenden by A. G. Bailey. **Storage Rot** (*Penicillium gladioli* McCulloch & Thom) was noted on corms, while **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst.) was seen in two crops in S. Wales. **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) was confirmed on old corms in Ches.

GLOBE FLOWER **Leaf Spot** (*Phyllosticta trollii* Trail) was identified on leaves from Surrey in 1963: it appeared to be new in England and Wales but Grove (*Br. Coelomycetes*, **1**, p. 49) refers to a Scottish record of the disease on wild globe flower. There were a few further reports of **Smut** (*Urocystis anemones* (Pers.) Wint.). (Plate XV, 1). **Cucumber Mosaic** virus was confirmed on *Trollius* in the west Midlands.

GLOXINIA see Sinningia.

GODETIA Further reports were received of **Wilt** (*Diplodina passerinii* Allesch.) (see p. 179) and **Foot Rot** (*Pythium* sp.), both from a Bristol nursery. **Root Rot** (*Phytophthora cactorum* (Leb. & Cohn) Schroet.) was recorded at Bristol also: an earlier report had come from Scotland (Moore, *Br. Parasitic Fungi*, p. 264).

GRAPE HYACINTH Of interest on *Muscari* were **Black Slime** (*Sclerotinia*

bulborum (Wakk.) Rehm) which was confirmed in a small consignment imported into the south-west from the Netherlands and rarely recorded previously, and **Rust** (*Uromyces muscari* (Duby) Lév.) which was noted in Glos.

GYNURA Most of the 500 plants of *Gynura scandens* on a Lee Valley nursery were affected by **Stem Rot** (*Phytophthora* sp.) in 1964: no earlier records of *Phytophthora* on *Gynura* in this country were found. **Root Rot** (*Pythium* sp.) was confirmed in Glos.

HAWTHORN **Leaf Blight** (*Entomosporium thuemenii* (Cke.) Sacc.) was identified in specimens from Devon in 1964, being confirmed at C.M.I., Kew. This was believed to be a new record for Britain. In 1966 the fungus was found on cv. Standard Monarch in Sussex. **Verticillium Wilt** (*Verticillium dahliae* Kleb.) was found in young trees in Sussex: there were no earlier records for this country. Also newly recorded on hawthorn and seen on several occasions (Brooks, *Jl R. hort. Soc.* 1966, **91**, p. 6) was **Leaf Spot** (*Fabraea maculata* Atk.). **Leaf Blotch** (*Monilinia johnsonii* (Ell. & Ev.) Honey) was unusually severe in the south-east, from Suffolk to Sussex, in spring 1964 (Dennis, *Pl. Path.* 1965, **14**, 46). **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was seen also. **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) is common on hawthorn (p. 256); it has been recorded on various species of *Crataegus* and on *Crataegomespilus* (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

HEDYSARUM Plants of *Hedysarum coronarium* ('Sulla'), known on the European continent as 'French honeysuckle' but little grown in this country, were found to be affected by **Verticillium Wilt** (*Verticillium dahliae* Kleb.) (Milton and Isaac, *Pl. Path.* 1967, **16**, 71-5). The disease occurred at the Grassland Research Institute, Hurley, Berks and had not previously been recorded.

HELIOPSIS **Stem Rot** (*Phytophthora* sp.) occurred in Sussex in 1966.

HELIXINE *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was recorded, variously causing **Damping-off** and **Stem Rot.**

HELLEBORE Plants of *Helleborus foetidus* and *H. carscicus* from Oxon had **Crown and Stem Rot** (*Phytophthora* sp.), the trouble being associated with waterlogging.

HEUCHERA A new host of **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) for this country.

HIPPEASTRUM Plants with streaks on the leaf bases were found to contain **Cucumber Mosaic** virus (Hollings *et al.*, *Rep. Glasshouse Crops Res. Inst. 1966*, 101).

HOLLY Another record of **Violet Root Rot** (*Helicobasidium purpureum* Pat.) came from the Evesham Area: the disease had been seen in 1934 (Moore, *Br. Parasitic Fungi*, p. 184). *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was troublesome in cuttings on one occasion, killing many leaves.

HONESTY **Club Root** (*Plasmodiophora brassicae* Woron.) was reported from Cards, and **Foot Rot** (*Phytophthora* sp.) from Devon.

HONEYSUCKLE see Lonicera.

HORNBEAM **Canker** (*Nectria galligena* Bres.) killed bushes in a hedge in Cards in 1967: cankers occurred on the trunks.

HORSE CHESTNUT **Leaf Blotch** (*Guignardia aesculi* (Peck) Stewart)

had been noted on nursery stock in 1953 (Moore, *Br. Parasitic Fungi*, p. 179) and the fungus was recorded earlier (Grove, *Br. Coelomycetes*, **1**, p. 4). During the 10 years prior to the present review, the disease had been seen several times (Hants, Glos, Norfolk, Suffolk) on mature trees (Pawsey, *Pl. Path.* 1962, **11**, 137-8) usually with the fungus in the imperfect state (*Phyllosticta paviae* Desm.) but the *Guignardia* stage was found in the Thetford area. In 1962, severe defoliation occurred in several drifts of 1-and 2-year old stock trees in a Surrey nursery. Pycnidia containing pycnidiospores, and spermagonia containing spermatia (see Stewart, *Phytopathology*, 1916, **6**, 12-13), were found, and pycnidia were also found on the buds. More attacks on half a dozen or so nurseries in Surrey followed in 1963; on each nursery it was bad in young stock, particularly on newly-budded plants. Defoliation and bud death were features. In 1964 the disease was widespread in Hants and occurred in Berks, and in 1967 it became severe and widespread in these two counties. Other reports came from Devon. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found on this host.

HYACINTH **Grey Bulb Rot** (*Sclerotium tuliparum* Kleb.) was mentioned in the odd report. **Cucumber Mosaic** virus has been isolated from diseased hyacinths (Brunt, *Rep. Glasshouse Crops Res. Inst. 1963*, 89).

HYDRANGEA In 1965 an attack of **Leaf Spot** was suspected to be caused by *Phyllosticta hydrangeae* Ell. & Ev. (Saccardo, *Syll. Fung.* **10**, p. 105). In 1967 a small proportion of the cuttings on a Lee Valley nursery showed leaf spots caused by *Ascochyta* sp. J. T. Fletcher reported that the spots, which were up to well over a centimetre in diameter and had dark brown centres, showed a concentric pattern, and that the numerous pycnidia on both upper and lower surfaces contained spores measuring 4·5 - 8 μm x 3 μm. No other record of *Ascochyta* on hydrangea was traced for this country. The odd outbreak of **Foot Rot** or **Root Rot** was associated with *Phytophthora* sp., and **Oedema** (non-parasitic) was also noted.

HYPERICUM **Rust** (*Melampsora hypericorum* Wint.) was recorded in War, Berks, Sussex, Glos, Cards and Merioneth. The disease was troublesome in gardens in 1968 (Brooks, *Jl R. hort. Soc.* 1969, **94**, 4-10).

IRIS **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst.) was the most common fungal trouble, but **Ink Disease** (*Bipolaris iridis* (Oudem.) Dickinson) can be damaging in the south-west in some seasons. **Rust** (*Puccinia iridis* Rabenh.) is not common on irises but was noted in Norfolk, Kent and Caerns. A planting in Cornwall was affected by **White Root Rot** (*Rosellinia necatrix* Prill.). In 1964, *Phytophthora* sp. caused **Leaf Rot** in small patches in a crop in the Scilly Isles: the fungus did not differ from the *Phytophthora*, not unlike *P. cyperi-rotundati* Sawada, previously reported from the Scilly Isles and Cornwall (Gibson and Gregory, *Trans, Br. mycol. Soc.* 1940, **24**, 251-4). In an outbreak of **Stem Rot** (*Botrytis cinerea* Fr.), plants had yellowed foliage with a severe constriction and rotting of the stem bases reminiscent of tulip shanking. *Erwinia carotovora* (Jones) Bergey *et al.* var. *atroseptica* (van Hall) Dye was said to be responsible for root death in some transplanted *Iris foetidissima* plants. Iris **Mosaic** virus, which is extremely prevalent in iris stocks, has been isolated from Spanish, English and Dutch types and also from *I. danfordiae* and *I. reticulata* but not from rhizomatous iris (Brunt, *Ann. appl. Biol.* 1968, **61**, 187-94). Mosaic

symptoms are, however, prevalent on rhizomatous irises in Britain and **Cucumber Mosaic** virus is often associated (*loc. cit.*). **Bud Blast** (non-parasitic) was recorded.

IVY **Leaf Spot** (*Colletotrichum trichellum* (Fr.) Duke) appeared in several reports: in the Lee Valley it was associated with rot of petioles as well as with necrosed areas on leaves. *C. dematium* (Fr.) Grove also occurs in ivy in Britain and has been considered to be parasitic (Sutton, *Trans. Br. mycol. Soc.* 1962, **45**, 222-32). *Phytophthora* sp. and *Pythium* sp. were variously involved in the odd root troubles.

JUDAS TREE A wilt of shoots of *Cercis siliquastrum* in Som was attributed to *Botrytis cinerea* Fr.

JUNIPER In 1966, a **Die-back** of branches with browning of vascular tissues and death of leaves occurred in a stock plant on a nursery in Glos: *Sclerophoma pithyophila* (Corda) Höhn. and *Phomopsis juniperovora* Hahn were isolated and identified by C.M.I., Kew. *S. pithyophila* was known on *Pinus*, but not on juniper in this country, while *P. juniperovora* appeared not to have been recorded here. The latter fungus was seen again in War in 1968. In the Evesham Area, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. caused basal rot of a batch of cuttings in a peat and sand mixture.

KALANCHOE **Stem Rot** (*Botrytis cinerea* Fr.) (see p. 183) was sometimes severe. Several other fungi were newly recorded as agents of disease in kalanchoe in this country: **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) in Devon, **Verticillium Wilt** (*Verticillium dahliae* Kleb.) in Kent, **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) which was severe on two nurseries in the Lee Valley, **Stem Rot** (*Pythium* sp.) in the Lee Valley, and **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) and **Leaf Spot** (*Ascochyta* sp.) in Caerns. The *Pythium* was isolated from basal lesions of plants which had suddenly collapsed or wilted: often only one side of the plant, one or two branches only, was affected. The outbreak of both *Thielaviopsis* and *Ascochyta* on a Caerns nursery was severe, but inadequate sterilization was a main factor. A virus disease in the Lee Valley caused severe reduction in size of leaves and deformation of flowers and leaves. **Oedema** (non-parasitic) was recorded.

KNIPHOFIA *Fusarium* sp. caused extensive **Wilt** and **Crown Rot** in a planting in Surrey in 1966.

LABURNAM The *Fusarium lateritium* Fr. stage of *Gibberella baccata* (Wallr.) Sacc. was confirmed in Caerns on trees showing **Die-back** and **Canker,** apparently a new host record, though Peace (*Pathology of Trees and Shrubs*, p. 508) had reported *Fusarium* sp. in association with die-back on a Glos nursery. Another die-back was associated with *Phomopsis rudis* v. Höhn., the pycnidial stage of *Diaporthe rudis* Nits. *P. rudis* had been recorded a few times earlier on dead laburnum twigs (Grove, *Br. Coelomycetes*, **1**, pp. 194-5).

LAELIA **Rust** (*Hemileia oncidii* Griff. & Maubl.) was recorded from Som (see also Oncidium).

LARKSPUR see Delphinium.

LAVENDER In Kent, **Grey Mould** (*Botrytis cinerea* Fr.) appeared to be involved in death of shoots of a few plants; while **Damping-off** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was troublesome in a batch of unrooted cuttings.

LILAC **Wilt** (*Phytophthora syringae* (Kleb.) Kleb.) attacked three cultivars on a nursery in Leics in 1964: the fungus was isolated from lesions on branches being layered in soil. Wilt has previously been seen at several places in Scotland (Moore, *Br. Parasitic Fungi*, p. 280). *Cladosporium herbarum* (Pers.) S. F. Gray had disfigured lilacs examined in Merioneth.

LILY *Fusarium oxysporum* Fr. f. *narcissi* Snyder & Hansen was confirmed on the roots of plants dropping leaves prematurely in Sussex.

LIME In 1967, **Stem Canker** (*Cercospora exitiosa* H. & P. Sydow) was identified, for the first time in Britain, on nursery trees of *Tilia europaea* var. *pallida* in Middx (Reid, *Trans. Br. mycol. Soc.* 1969, **52**, 19-38). These trees had been imported from the Netherlands some 20 months earlier, and nearly all were found to be infected in 1967: they were destroyed. **Leaf Spot** (*Gloeosporium tiliae* Oudem.) was widespread in several trees examined in Herts in 1967: constricting lesions on petioles led to premature leaf-fall. Recorded again were **Verticillium Wilt** (*Verticillium dahliae* Kleb.) (see p. 184), in Surrey in 1964, and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer). *Aureobasidium pullulans* (de Bary) Arn. and *Cladosporium herbarum* (Pers.) S. F. Gray are the chief components of the frequently seen **Sooty Mould** condition (Friend, *Trans. Br. mycol. Soc.* 1965, **48**, 367-70).

LOBELIA **Leaf Spot** (*Alternaria alternata* (Fr.) Keissler), first reported on p. 185, has caused heavy losses and is a major problem in this crop. Reports came from many areas and included damping-off and spotting of the flowers: where checks were made the fungus was confirmed on incubated seeds. The apparent absence of the disease from the Lee Valley in 1968 was attributed to the use of seed treated by merchants by the thiram-soak method, and this was being used successfully in other areas. *A. tenuissima* (Pers.) Wiltshire was identified at C.M.I., Kew, in material from places in the West Midland Region in 1966 and was important as a cause of stem rot and leaf spot in the Region. **Damping-off** troubles were variously caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., *Phytophthora* sp. and *Phoma* sp.

A species of *Xanthomonas* was isolated from plants showing **Leaf Spot**, and from seeds, of cv. Mrs. Clibrian in the Lee Valley in 1967. The youngest leaves bore small, water-soaked spots, while mature plants had stem lesions at soil level and eventually wilted and died. *Xanthomonas* was isolated also from lesions on cotyledons and on young leaves in an investigation of the problem at N.V.R.S., Wellesbourne, and symptoms were obtained in seedlings from both artificially and naturally infected seed (Taylor, *Rep. natn. Veg. Res. Stn, 1967*, 82). In one instance in the Lee Valley a species of *Pseudomonas* in Group IVb was isolated from plants with leaf spot.

LONICERA Observations on **Die-back** (*Botrytis cinerea* Fr.) of *L. fragrantissima* were made over several years (Morgan, *Trans. Br. mycol. Soc.* 1968, 435-9) at Exeter: no previous published reference to this trouble had been traced. **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was recorded in Glos. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) and **Cucumber Mosaic** virus were recorded on honeysuckle.

LOQUAT **Scab** (*Venturia pirina* Aderh.) was identified on leaves of

Eriobotrya japonica (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 6). This material came from Kent (Brooks, pers. comm.).

LUPIN **Verticillium Wilt** (*Verticillium alboatrum* Reinke & Berth.) severely attacked tree lupin at one place in Berks. According to Griffiths and Isaac (*Hort. Res.* 1963, **2**, 104-14) this is the most pathogenic species of *Verticillium* involved in lupin wilt. **Die-back** (*Botrytis cinerea* Fr.) was noted. **Alfalfa Mosaic** virus occurs widely in named Russell lupin cultivars and **Lupin Mottle** virus mostly in seedling lupins (Hull, *Ann. appl. Biol.* 1968, **61**, 373-80), the latter virus being a previously undescribed strain of the bean yellow mosaic virus/common pea mosaic virus complex. Alfalfa mosaic had affected all stocks of many clonally-propagated cultivars of Russell lupin on a nursery in Staffs, rendering many of them valueless. This virus is by far the most frequent cause of leaf patterns and associated symptoms in clonally-propagated Russell lupins in the west Midlands.

LYCHNIS **Leaf Spot** (*Septoria sinarum* Speg.) in Oxon in 1968 (identity of fungus confirmed at C.M.I., Kew) was believed to be new for this host, but the disease is known on sweet william (Moore, *Br. Parasitic Fungi*, p. 263).

LYTHRUM *Verticillium dahliae* Kleb. was isolated from plants with **Verticillium Wilt** in Berks in 1962: no other records of the fungus on this host were found.

MAGNOLIA **Leaf Spot** (*Phyllosticta magnoliae* Sacc.) was recorded on a few occasions; and **Die-back** was sometimes associated with *Nectria cinnabarina* (Fr.) Fr. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was again recorded.

MAHONIA Not mentioned in Part I but noted in reports in the latter seven years were **Rust** (*Cumminsiella mirabilissima* (Peck) Nannf.) and **Leaf Spot** (*Phyllosticta mahoniae* Sacc. & Speg.), the latter causing considerable disfiguration of *Mahonia bealei*.

MALUS **Scab** (*Venturia inequalis* (Cooke) Wint.) affects many varieties of ornamental crab apple and is commonly seen. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) were also found. **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) has occurred on *Malus florentina* (Lelliott and Hayward, *Pl. Path.* 1956, **14**, 141-2).

MAPLE Earlier outbreaks of **Verticillium Wilt** were mentioned on p. 186. In each instance the fungus was *Verticillium dahliae* Kleb. More outbreaks were reported during 1962-8: *V. dahliae* was confirmed in *Acer dascycarpum*, *A. griseum*, *A. negundo*, *A. negundo-variegatum*, *A. palmatum*, *A. platanoides*, *A. pseudoplatanus*, *A. pyramidalis* and *A. rubrum dissectum*. *V. alboatrum* Reinke & Berth. was confirmed on two occasions, in one the bark was cracked vertically and the vascular tissue stained grey-green. In one of the outbreaks involving *V. dahliae*, the fungus was isolated from branches showing silvered cankers at the nodes, and a species of *Phomopsis* also present was presumed to be secondary: in another the dead uppermost parts were colonized by *Stagonospora lophiostoma* Sacc. which was assumed to be saprophytic (the fungus was earlier recorded on dead twigs of sycamore in Grove, *Br. Coelomycetes*, **1**, pp. 345-6). In one of the reports of **Coral Spot** (*Nectria cinnabarina* (Fr.) Fr.) the fungus was found on young trees budded two years earlier, and infection was thought to have occurred at the cut end of the rootstock.

MARIGOLD (Tagetes) In 1966, *Pseudomonas marginalis* (Brown) Stevens was isolated from brown lesions on the leaves of plants in Herts, and *Ps. cichorii* (Swingle) Stapp was associated with leaf spots on a nursery in Essex.

MATRICARIA **Powdery Mildew** (*Oidium* sp.) developed on pot plants at Fairfield Experimental Horticulture Station, Lancs in 1964: no earlier records were traced.

MECONOPSIS **Root Rot** (*Phytophthora* sp.) occurred on *Meconopsis betonifolia* in Salop in 1965.

MEDLAR *Monilinia mespili* (Schell) Whetzel regularly and heavily affects *Mespilus germanica* at the Royal Botanic Gardens, Kew (Dennis, *Pl. Path.* 1965, **14**, 46) and occurs also on *Crataegomespilus* spp. there.

MESEMBRYANTHEMUM An outbreak of **Downy Mildew** (*Peronospora mesembryanthemi* Verwoerd) on seedlings of *Dorotheanthus bellidiformis* (*Mesembryanthemum criniflorum*) in 1966 appeared to be the first for Britain and indeed for Europe (Bradley Jones and Dickens, *Pl. Path.* 1967, **16**, 192). **Root Rot and Stem Rot** attributed to *Rhizoctonia* sp. were severe on mesembryanthemum seedlings on a Hants nursery.

MICHAELMAS DAISY The main interest with this host was in the newly recorded septoria leaf spots. In autumn 1968 *Septoria astericola* Ell. & Ev. was identified by my colleague A. G. Bailey on material of *Aster amellus* from a nursery in Norfolk. Seven of 16 cultivars were affected but Rudolphe Goethe most seriously. Later that year Bailey identified *S. atro-purpurea* Peck on *A. novi-belgii* from a nursery in Berks, and from another in Oxon where the fungus was present on all cultivars being grown. C.M.I., Kew confirmed the identities of the fungi, and both records were believed to be the first for Europe. In 1962, H. J. Wilcox had found a species of *Septoria* on several *A. novi-belgii* cultivars on a nursery in the Wye Sub-Region: the leaf spots were dark brown and up to 3 cm in diameter. The, mostly sunken pycnidia exuded tendrils of cream-coloured spores; the spores being pluriseptate, undulate and from 50-120 μm x 2-3 μm. Only cv. Trixie in the Pygmaea section was affected. Wilcox's *Septoria* was the first to be noted on a species of *Aster* in this country.

MULLEIN A **Powdery Mildew** (*Oidium* sp.) which was severe on a nursery in Merioneth in 1966 was of interest.

MYOSOTIS **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) was severe in a cold glasshouse in Ches.

NARCISSUS **Basal Rot** (*Fusarium oxysporum* Fr. f. *narcissi* Snyder & Hansen), **Smoulder** (*Sclerotinia narcissicola* Greg.), **White Mould** (*Ramularia vallisumbrosae* Cav.) and **Leaf Scorch** (*Stagonospora curtisii* (Berk.) Sacc.) were the most frequent problems facing advisers. Smoulder had been increasing in importance in the Eastern Region. White mould is probably a main factor in the degeneration and poor flowering which occurs in the south-west in stocks of the late-flowering cvs. Cheerfulness and Double White (Jenkins and Hawken, *Pl. Path.* 1969, **18**, 122-9). *Fusarium moniliforme* Sheldon var. *subglutinans* Wollenw. and Reink., the imperfect state of *Gibberella fujikuroi* (Saw.) Ito ap. Ito & Kimura var. *subglutinans* Edwards, was isolated from cv. Grand Soleil d'Or flowers sent to the Starcross Sub-Centre from I. of Scilly early in 1967. The fungus was identified by Dr. C. Booth at C.M.I., Kew. S. C. Melville reported that the

centre of the flower bore white mycelium and that the anthers appeared to be infected first, then the corolla and finally the pedicel. Usually only two or three flowers had opened but in a few instances the unopened bud had rotted. Incidence in the field was low. *Armillaria mellea* (Fr.) Kummer has again been found in daffodil bulbs (Brooks, *Jl R. hort. Soc.* 1969, **94**, 4-10). **Root Rot** and basal plate rot were associated with *Pythium* sp. in a crop in Cumb. *Rhizopus* sp. accompanied a soft rot in two lots of bulbs from Lincs: in both instances the bulbs had been held in warm storage and subjected to temperatures of 35°C for two or three days.

Narcissus **Mosaic** and narcissus **Yellow Stripe** viruses are widespread. Many commercial cultivars of the trumpet, large-cupped and double daffodils seem totally infected with the former (Brunt, *Ann. appl. Biol.* 1966, **58**, 13-23). Surveys have shown the occurrence of several other viruses in narcissi in this country (Brunt, *Pl. Path.* 1966, **15**, 157-60). In these surveys, **Cucumber Mosaic** virus was prevalent in cv. Grand Soleil d'Or in the Scilly Isles but was very rare in other commercial cultivars and in new cultivars under trial: **Tobacco Rattle** virus was found in several commercial daffodil stocks and **Arabis Mosaic** virus in a few: both were referred to on p. 188. **Strawberry Latent Ring Spot** virus has also been detected but this and arabis mosaic occurred only in complex with other viruses. **Tomato Black Ring** virus has been found in Soleil d'Or in the Scilly Isles (Brunt, *Rep. Glasshouse Crops Res. Inst. 1963*, 89). Narcissus **Latent Virus,** recently detected, appears to be common (Brunt, ibid. *1967*, 102), while narcissus **Silver Leaf** virus (the disease has been referred to as white streak, silver streak, silver leaf, early maturity or early decline) has occurred sporadically in Britain and was prevalent in 1967 in some stocks of cvs. Golden Harvest, Fortune and Havelock (Brunt, ibid. 103). **Hot-water Treatment Injury** was widespread in west Norfolk in 1962 and there were other reports. Scattered plants of cv. Cheerfulness in all the flower growing area of the Starcross Sub-Region showed a **Green Flower** condition in April 1968: the petals were green and the disorder was similar to that found also in Jersey in several crops of cv. Yellow Cheerfulness.

NASTURTIUM *Acroconidiella tropaeoli* (Bond) Lindquist & Alippi (syn. *Heterosporium tropaeoli* Bond) was recorded for the first time in Britain, and apparently Europe, in stocks at the Royal Horticultural Society's Trials at Wisley in 1968 (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 7).

NEMESIA **Leaf Spot** (*Colletotrichum* sp.) (see also p. 189) was found in boxes of bedding plants on a nursery in War: spore sizes averaged 12 μm x 3 μm. At the Evesham Area Laboratories similar necrotic spots were produced when agar containing the fungus was placed onto healthy leaves. Severe **Damping-off** on a nursery in Lancs in 1962 was attributed to *Alternaria* sp, and the fungus was found on a sample of the seed used. **Root Rot** and similar troubles were occasionally caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. and *Phytophthora*.

NEPETA **Powdery Mildew** (*Oidium* sp.) was severe on a nursery in Yorks W.R.: a mildew on this host was previously seen in 1956 (Moore, *Br. Parasitic Fungi*, p. 223). **Cucumber Mosaic** virus has been isolated (Hollings and Stone, *Rep. Glasshouse Crops Res. Inst. 1964*, 96).

NERINE **Fusarium Bulb Rot** (*Fusarium oxysporum* Fr.) was confirmed in 1962 in Devon. The disease was seen some years earlier in Guernsey by

D. J. Harrison (pers. comm.) who confirmed the pathogenicity of the fungus to nerine by inoculation. Severe brown spotting of flowers and bracts, resulting in heavy losses, in a Cornish crop in 1967 was caused by **Leaf Scorch** (*Stagonospora curtisii* (Berk.) Sacc.). The first British report of the fungus on the genus had come the previous year when two *Nerine* species from Dorset had been found to be affected (Brooks, *Jl R. hort. Soc.* 1966, **91**, 498). A virus was suspected when three cultivars of nerine showed yellow and pale green stripes, several cm long, in the Evesham Area in 1967 and again when the plants were grown on in 1968.

NIGELLA On a nursery in Cambs in 1966, stunting, chlorosis of the lower leaves and a purplish brown staining of the vascular tissue was associated with *Pseudomonas marginalis* (Brown) Stevens.

NYMPHAEA Reid (*Trans. Br. mycol. Soc.* 1969, **52**, pp. 25-6) identified *Rhamphospora nymphaeae* D.D. Cunn. on lesions on leaves of *Nymphaea alba* on a few occasions in the south-east and, although these were the first records for Britain, he suggested that the fungus is probably not uncommon.

OAK **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was recorded.

ODONTOGLOSSUM A **Leaf Blotch** in Dorset in 1968 was attributed to *Glomerella cingulata* (Stonem.) Spauld. & Schrenk: this appeared to be a new host record for this country.

ONCIDIUM **Rust** (*Hemileia oncidii* Griff. & Maubl.) was present on specimens from Som in 1963. The uredo stage (*Uredo bechnickiana* P. Henn.) had been found on imported *Oncidium varicosum* in 1909 (Moore, *Br Parasitic Fungi*, p. 187). **Leaf Spot** (*Colletotrichum orchidearum* Allesch.. was reported from Kent on plants dying-back.

ORCHID see Cymbidium, Cypripedium, Odontoglossom, Oncidium.

ORNITHOGALUM **Leaf Spot and Leaf Rot** (*Heterosporium ornithogali* Cooke) was confirmed in Suffolk; and also in Devon (Brooks, *Jl R. hort.* Soc. 1966, **91**, 3-6). Very striking symptoms on all plants on a nursery in Oxon in 1967 were diagnosed as ornithogalum **Mosaic,** a disease known in U.S.A. The rare **Rust** (*Puccinia liliacearum* Duby) (see Moore, *Br. Parasitic Fungi*, p. 306) was identified by Dr. D. M. Henderson in specimens collected by P. J. Shipton in a garden in Cambs in 1968.

PAEONY **Red Spot** (*Cladosporium paeoniae* Passer.) was recorded in a garden in Som in 1962 and at Bristol in 1968: no other records were traced for England and Wales but the disease has been seen in Scotland (Moore, *Br. Parasitic Fungi*, p. 100). The *Coniothyrium fuckelii* stage of the **Stem Wilt** fungus *Leptosphaeria coniothyrium* (Fuckel) Sacc. was confirmed in July 1965 on tree paeonies imported the previous winter from Japan. This fungus, the cause of cane blight of raspberry and of stem canker of rose was unknown in this country on tree paeony. However, in U.S.A., it is responsible for stem-wilt in these plants, the wilting flowering stems quickly dying following girdling of the stem base by cankers (Pirone, Dodge and Rickett, *Diseases and Pests of Ornamental Plants*, 1960, p. 525, New York: The Ronald Press Co). An outbreak of **Bud Blast** in Dorset was attributed to *Botrytis cinerea* Fr.: and Reid (*Trans. Br. mycol. Soc.* 1969, **52**, 19-28) found two further outbreaks of the rare **Rust** (*Cronartium flaccidum* (Alb. & Schw.) Wint.), one in 1960 in Dorset and the other in 1966 in Sussex.

PANSY see Viola.

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PARTHENOCISSUS **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted in Surrey—apparently a new host record.

PASCHIA A **Powdery Mildew** (*Oidium* sp.) was noted in Devon in 1965: no earlier reports had been received.

PELARGONIUM **Rust** (*Puccinia pelargonii-zonalis* Doidge) was first found in Europe in 1962 and within a few years reached England. In 1965 it was identified on zonal pelargoniums from the Parks Department at Eastbourne, Sussex (Evans, *Pl. Path.* 1966, **15**, 144). In 1966 several further outbreaks occurred in the same county and by 1967 it was apparent that the rust was widely distributed in southern counties from Kent to Devon, and it had also appeared in the Eastern Region and in Wales. By 1968 it has been found as far north as Lancs (on stock from Sussex) and Yorks W.R., and had been reported in the west Midlands and the Lee Valley as well as in the south. Another newly reported problem, from 1963, was **Leaf Spot** (*Alternaria alternata* (Fr.) Keissler): reports came from the Evesham Area and the Lee Valley (Fletcher and Ryan, *Pl. Path.* 1966, **15**, 69-70), and elsewhere, and both regal and zonal pelargoniums were affected. **Verticillium Wilt** was diagnosed in a few crops and was sometimes a problem; both *Verticillium dahliae* Kleb. and *V. alboatrum* Reinke & Berth. were identified on several occasions. Neither fungus had been recorded before on pelargonium in England and Wales but *V. dahliae* has been detected in geranium in Jersey (Moore, *Br. Parasitic Fungi*, p. 426). **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) was noted, **Root Rot** (*Nectria radicicola* Gerlach & Nilsson syn. *Cylindrocarpon destructans* (Zins.) Scholten) affected a batch of plants in poor growing conditions in Middx in 1968. *Fusarium* sp. was involved in a **Foot and Stem Rot** in the Evesham Area and probably followed damage by insect larvae. Several species of *Pythium* seemed to be involved in stem or root rots, which were recorded a few times: sometimes plants progressively wilted. An unusual **Leaf Blotch** which developed in 1968 on two nurseries in Yorks W.R. and Lancs respectively appeared to be caused by *Phytophthora* sp.: the large black lesions were on the lower leaves at first but progressed upwards until most leaves were affected. **Rust** (*Uromyces geranii* (DC.) Fr.) was recorded on *Geranium* in Surrey in 1968; it was last recorded on cultivated geraniums in 1933. **Downy Mildew** (*Plasmopara pusilla* (de.B.) Schroet.) was identified by my colleague A. G. Bailey on a cultivated hardy *Geranium* sp. from Surrey: the fungus had apparently not been recorded on cultivated plants previously in this country though it had been found on wild *Geranium* spp.

The importance of **Leaf Spot and Stem Rot** (*Xanthomonas pelargonii* (Brown) Starr & Burkh.) was increasing in the Lee Valley, and towards the end of the period it became a serious problem. A severe outbreak in 1964 was the first record for the Wye Sub-Region. Unidentified *Pseudomonas* spp. were involved in odd instances of black stem rotting or severe defoliation. Pelargonium **Leaf Curl** virus (Plate XI, 1) was commonly encountered, while **Cucumber Mosaic** virus was confirmed in Yorks E.R. in a crop showing streaked petals. Hollings, writing in 1962 (*Ann. appl. Biol.* **50**, 189-202), considered that leaf curl virus, although widely distributed in pelargonium stocks was not a threat to commercial cultivation in this country.

PENSTEMON A *Pseudomonas* species in Group Vb was isolated from plants showing **Leaf Spot** in Essex in 1966.

PEPEROMIA *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. severely affected cuttings on the odd occasion. In one instance in the Lee Valley, circular, light-brown lesions occurred on the leaves and stems and were often associated with a soft wet rot of the petiole: the trouble was controlled when a quintozene spray was used.

PERIWINKLE There were two further records of the rather rare **Rust** (*Puccinia vincae* Berk.), from Cornwall and Hants respectively; in the latter, *Tuberculina sprozzei* had infected the rust. *Rhizoctonia* sp. was noted causing **Stem Rot.**

PETUNIA Newly recorded on this host were **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary) in Sussex and Oxon and **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) in Carms. In one outbreak of the former, losses were severe. **Cucumber Mosaic** and tomato **Aspermy** viruses were both confirmed on this host, the latter in plants from Beds.

PHILADELPHUS *Verticillium dahliae* Kleb. was isolated from affected plants in Berks: no other records of **Verticillium Wilt** on this host were traced.

PHLOX While *Verticillium dahliae* has been noted on a number of occasions previously, a report of *V. alboatrum* Reinke & Berth. in a garden in Montgomery in 1963 was apparently the first for this fungus in this country though it is known to cause wilt in phlox abroad. **Stem Rot** (*Phoma phlogis* Roum.), formerly recorded in Scotland (Moore, *Br. Parasitic Fungi*, p. 246) was identified on stunted perennial phlox whose leaves were drooping and dying in Brecon in 1966. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was involved in the odd outbreak of **Stem Rot** or **Root Rot.** *Ramularia* sp. (with *Septoria drummondii*) caused severe **Leaf Spot** in seedlings at Bristol in 1967. Symptoms reminiscent of **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn) were noted on two occasions and in one the disease was said to have been confirmed. A bad attack of **Powdery Mildew** (*Oidium* sp.) on a pink cultivar occurred in a garden in Cambs but an adjacent white cultivar remained unaffected. *Erysiphe cichoracearum* Mérat has previously been identified on phlox (Moore, *Br. Parasitic Fungi*, p. 141).

PILEA *Pythium* sp. was detected in the roots of plants showing leaf drop. On a nursery in the Lee Valley, **Oedema** (non-parasitic) was present on the undersides of leaves, stems and petioles on plants whose leaves were also covered by an alga.

PINE **Needle Cast** (*Lophodermium pinastri* (Fr.) Chevall.) was noted on *Pinus radiata*, and the aecidial stage of the **Rust** *Cronartium ribicola* J. C. Fischer on *P. ayacahuite* and *P. strobus*.

POINSETTIA *Pythium* sp. and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. were involved in various root troubles, and also attacked cuttings. *Cylindrocarpon* sp. and *Fusarium* sp. appeared to be causing basal rot in one batch of cuttings which were failing to root. One or two attacks of **Stem Rot** were attributed to *Erwinia carotovora* (Jones) Bergey *et al.* var. *atroseptica* (van Hall) Dye.

POLYANTHUS see Primula.

POPLAR **Leaf Spot** (*Marssonina populi* (Sacc.) Magn.) and **Yellow Leaf Blister** (*Taphrina populina* Fr.) were commonly seen. A severe attack of **Leaf Spot** (*Phyllosticta populina* Sacc.) occurred in Sussex on *Populus robusta*. *Cytospora chrysosperma* Fr. was noted on dying twigs. A species of *Venturia* thought to be *V. populina* (Vuill.) Fabr. was found on young trees in Caerns in 1966. There has been some confusion about *Venturia* spp. on poplars, and Peace (*Pathology of Trees and Shrubs*, pp. 451-2) mentions a single record of *V. tremulae* from Dorset but no British records of *V. populina*. The causal agent of **Bacterial Canker and Die-back** is now known to be *Aplanobacter populi* Ridé, while *Pseudomonas syringae* van Hall is of minor consequence in this respect (Whitbread, *Ann. appl. Biol.* 1967, **59**, 123-31) though it may cause shoot blight in spring.

POPPY **Verticillium Wilt** (*Verticillium dahliae* Kleb.) has again been recorded. Two troubles were reported on oil seed poppies in Herefs in 1965, **Downy Mildew** (*Peronospora arborescens* (Berk.) de Bary), which is reputedly not uncommon on *Papaver* and *Meconopsis* (Moore, *Br. Parasitic Fungi*, p. 233), and **Black Mould** (*Cladosporium herbarum* (Pers.) S. F. Gray and *Alternaria* sp.) which severely affected part of a commercial crop.

POTENTILLA *Pythium* sp. affected all cuttings in 50 boxes, the cuttings failing to root.

PRIMULA **Flower Scorch** (*Itersonilia perplexans* 'Derx) on polyanthus was noted in 1962 and 1964 in the extreme south-west. **Violet Root Rot** (*Helicobasidium purpureum* Pat.), first recorded on *Primula* in 1952 (Jenkins, *Pl. Path.* 1953, **2**, 106), appeared in Glam on polyanthus. *Alternaria* sp. was involved in a severe **Root Rot** of polyanthus seedlings in Berks. *Pseudomonas* sp., associated with widespread **Leaf Spot** in a crop of polyanthus in Flints in 1965, was thought possibly to be *Ps. primulae* (Ark & Gardner) Starr & Burkh., but it had not yet been confirmed that this bacterium exists in this country. Another bacterial leaf spot, widespread on mature leaves of a Pacific strain on a Bucks nursery in 1967 was caused by a Pseudomonad in Group III. A Group II *Pseudomonas* sp. was isolated from plants of *Primula obconica* showing a necrotic leaf spot in I. of Ely in 1967. **Cucumber Mosaic** virus causes one of the more common diseases of polyanthus.

PRIVET A **Leaf Spot** (*Mycosphaerella ligustri* (Rob. in Desm.) Lindau) was noted causing defoliation, and another (*Cercospora ligustrina* Boerema) was recorded in Radnor, Norfolk and Dorset on *Ligustrum ovalifolium* between 1960 and 1962 (Deighton, *Trans. Br. mycol. Soc.* 1962, **45**, 474).

PRUNUS **Witches' Brooms and Leaf Curl** (*Taphrina cerasi* (Fuckel) Sadeb.) and **Blossom Wilt** (*Sclerotinia laxa* Aderh. & Ruhl.) were occasionally seen on ornamental *Prunus*, and **Leaf Curl** (*Taphrina deformans* (Berk.) Tul.) was not uncommon on flowering almond. A very extensive attack of **Leaf Spot,** with premature leaf fall, on a nursery in Sussex in 1966 was caused by a fungus which J. S. W. Dickens found to fit the description of *Phloeosporella padi* (Lib.) Arx (syn. *Cylindrosporium padi*) the imperfect stage of *Blumeriella jaapi* (Rehm) Arx. Scion cultivars were less affected than rootstock plants and their leaves were shot-holed. The fungus had been seen earlier on plum in Scotland (Moore, *Br. Parasitic Fungi*, p. 124) but not in England and Wales. A **Powdery Mildew** (*Oidium*

sp.) was seen on Portugal laurel (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 6). Other diseases recorded on *Prunus* spp. were shoot **Die-back** (*Botrytis cinerea* Fr.), **Heart Rot** (*Fomes annosus* (Fr.) Cooke) and **Bacterial Canker** (*Pseudomonas morsprunorum* Wormald). A bacterium differing in some ways from *Pseudomonas morsprunorum* and *Ps. syringae* was isolated from leaf spots and wilted shoots of *Prunus cerasifera* and appeared to be specifically associated with this species (Garrett and Crosse, *Rep. E. Malling Res. Stn, 1966*, 153): the disease was exceptionally severe in 1968 (ibid. *1968*, 32).

Cherry **Little Cherry** virus is common and widespread in England though all infected ornamental cherries seem to be symptomless carriers (Cammack, *Pl. Path.* 1966, **15**, 31-3). Also noted was **Prunus Necrotic Ring Spot** virus.

On cherry laurel (*Prunus laurocerasus*), **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) were both noted and a **Leaf Spot** (*Trochila laurocerasi* (Desm.) Fr.), not often seen in England (see Moore, *Br. Parasitic Fungi*, p. 394), was noted in Surrey in 1965. Also recorded on leaves of cherry laurel was *Stigmina carpophila* (Lev.) M.B. Ellis (syn. *Coryneum laurocerasi* Prill. & Delacr.) (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 7).

PYRACANTHA **Scab** (*Fusicladium pyracanthi* (Otth) Rostr.) was mentioned in reports from the south, the Evesham Area and Norfolk. **Twig Blight** (*Diplodia crataegi* Westd.) was reported by D. Humphreys-Jones in a garden in Merioneth. New shoots had wilted, the leaves turning brown and eventually black. It appeared to be a new host record, the fungus previously having been seen on *Crataegus* (Grove, *Br. Coelomycetes*, **2**, p. 39). Also an apparent new host record was that of **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) in Som in 1967. *Pyracantha* spp. are hosts of **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

PYRETHRUM A **Slow-wilt** disease was found on a few nurseries to the north of Cambridge in a main area for growing pyrethrums for cut flower production and was shown to be caused by a species of *Cephalosporium* with some close resemblance to *C. chrysanthemi* Zachos, Constantinou & Panagopoulos (Robertson, *Pl. Path.* 1967, **16**, 31-6). A species of *Puccinia* was found on specimens from a garden in Sussex in 1963 (Green and Brooks, *Jl R. hort. Soc.* 1964, **89**, pp. 129-30). Miss Brooks informs me that Dr. D. M. Henderson considered this fungus to be *Puccinia tanaceti* DC. Tomato **Aspermy** virus caused quilling of the florets and smaller flowers in dark red flowering varieties in 1965 in Merioneth.

PYRUS *Pyrus calleryana* was found as a host of **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*).

RANUNCULUS **Root Rot** (*Pythium* sp.) and **Cucumber Mosaic** virus were noted.

RHODODENDRON Young trees in open ground and others in pots in frames were dying from the stem base upwards on a nursery in Devon in 1964. Pycnidia were present on the stems and the fungus was identified at C.M.I. as *Phomopsis ericaceana* Fairm. This was probably the first time that the **Stem Rot** had been recorded in this country. A species of *Phomopsis* was isolated from the base of wilting stems of *Rhododendron*

ponticum stocks in pots on a nursery in Hants in 1965 and the trouble was thought to have been present for some years. **Leaf Blight** (*Cylindrocladium scoparium* Morgan) was newly recorded in 1964, being found on azaleas in I. of Ely. Another leaf blight of azaleas was caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.: this and **Damping-off** by the same fungus, which was recorded affecting azalea cuttings and seedlings at a few places during the period under review, had been found a few years earlier in Norwich (Storey, *Pl. Path.* 1955, **4**, 71). The same fungus caused necrosis of scion leaves, with failure of some unions and **Die-back** of stocks on bench-grafted rhododendrons in Staffs in 1967, while *Rhizoctonia* sp. had apparently killed azalea flower buds in a severe attack on imported plants which had suffered overheating after arrival. **Leaf Spot** (*Colletotrichum* sp.) was recorded in Merioneth in 1968 (see Peace, *Pathology of Trees and Shrubs*, pp. 527-8). Other newly reported troubles were **Wilt** (*Phytophthora cinnamomi* Rands) in potted rhododendrons in Lancs in 1968 and **Sooty Mould** (*Cladosporium* sp.) disfiguring azaleas in Merioneth in 1965.

The incidence of **Gall** (*Exobasidium vaccinii* (Fuckel) Woron.) (Plate IX, 3) in outdoor evergreen small-leaved rhododendrons has recently increased considerably (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 4). Several azalea cultivars were affected by **Petal Blight** (*Ovulinia azaleae* Weiss) in Dorset in 1968, with naturalized rhododendrons also substantially affected. Prevalent symptoms were spots on the petals, collapse of the corolla, and adherence of flowers to the trusses. The first report of petal blight in England is mentioned on p. 193. There was a further report of **Leaf Spot** (*Cercospora handelii* Bubák) on rhododendron; this was from Dorset in 1964. Other leaf spots on rhododendron were caused by *Pestalotiopsis guepinii* (Desm.) Steyaert, *Phyllosticta rhododendri* Westend., and *Botrytis* sp. which, also, was said to have caused **Bud Rot.** Also on rhododendrons were **Graft Disease** (*Pestalotia macrotricha* Kleb.), and **Crown Gall** (*Agrobacterium tumefaciens* (Smith & Townsend) Conn), which latter had affected up to 70 per cent of some cultivars, totalling 7,000 plants in a Surrey plantation.

RHOICISSUS A fungus causing **Leaf Spot** on many of a batch of *Rhoicissus rhomboides* in the Lee Valley in 1967 was confirmed at C.M.I., Kew as *Pestalotiopsis sydowiana* (Bres.) Sutton. This was believed to be a new host record but *P. sydowiana* has been found previously in this country (a 1960 isolate from *Erica caffra* root from Surrey is listed in the C.M.I. Culture Collection Catalogue, 1968).

ROSE **Black Spot** (*Diplocarpon rosae* Wolf) and **Powdery Mildew** (*Sphaerotheca pannosa* (Wallr.) Lév. var. *rosae* Wor.) are only too familiar. In the more recent years some growers in the Lee Valley have tended to use vegetatively propagated *Rosa indica major* rootstocks which are imported already budded, from the Mediterranean area and North Africa. It looked as though the excessive vigour of these plants in the first year would lead to a greater incidence of **Canker** caused by *Botrytis cinerea* Fr. Before the period under review. **Brand Canker** (*Coniothyrium wernsdorffiae* Laub.) had not been found on roses in England and Wales though it was known in Scotland (Moore, *Br. Parasitic Fungi*, p. 112). In 1962 the disease was found in Cards, and in 1966 in Salop and on many bushes on a nursery in the

Evesham Area. Some years ago, Bewley (*Rose Annu.* 1933, 110-2) found *Cylindrocladium scoparium* Morgan causing stem canker, but the fungus seems not to have been mentioned again in connection with rose diseases in this country until 1963 when miniature-rose cuttings in propagation beds on a Nottingham nursery suffered extensive **Damping-off** (Storey, *Pl. Path.* 1964, **13**, 112-3). The trouble recurred in later years, and on two Lee Valley nurseries in 1965 losses were severe in grafting pits, scions being rotted, particularly so where the graft union was below the level of the peat in the pit. **Leaf Spot** (*Sphaceloma rosarum* (Pass.) Jenkins) was noted in several areas, **Silver Leaf** (*Stereum purpureum* (Fr.) Fr.) was confirmed in Worcs and, the rarely reported **Canker** (*Myxosporium rosae* Fuckel) was seen in Salop. In 1967, half the graft unions in a batch of plants in wet frames in Notts was affected by *Chalaropsis thielavioides* Peyr., not previously troublesome in roses: the condition was improved by ventilation. *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was noted as a cause of **Die-back** of grafted plants on the propagating bench. Various fungi can be detected on roses which have died back in the field and may appear to be associated with the condition. It is of interest that an examination in the Wye Sub-Region of many shoots which were dying back in 1968 revealed the presence of 13 different species of fungi and in most, if not all, instances the basic trouble appeared to be physiological with the fungi mere colonizers of dead or dying tissues.

Arabis Mosaic virus (see also p. 195) and **Strawberry Latent Ring Spot** virus have been recorded on various occasions in England (Cammack, *Pl. Path.* 1966, **15**, 47). The latter virus has since been isolated from cv. Pink Sensation and, in 1965, from imported *Rosa rugosa* rootstocks on three nurseries in the Evesham Area and was recovered also from cultivars budded onto infected stocks. Infection was confirmed in *R. laxa*. In some, but not all, outbreaks, the nematode *Xiphinema diversicaudatum* was detected in the soil. Every year a supposedly non-parasitic **Leaf Drop** causes concern in the economically important cv. Baccara in the Lee Valley. Firstly, necrotic areas develop between the veins, usually at the petiole end of the leaf: with extension of the necrosis, leaves fall, sometimes within a day or two of the first symptoms. The problem was thought to be one of water relations.

ROWAN see Sorbus.

RUBBER-PLANT **Leaf Spot** (*Phyllosticta roberti* Boyer & Jacz.), noted in Cards in 1965, had not previously been observed in this country. The *Gloeosporium fructigenum* Berk. stage of the **Anthracnose** fungus (*Glomerella cingulata* (Stonem.) Spauld. & Schrenk) was confirmed on leaves of *Ficus decora* from Sussex in 1967: the occurrence of *Gloeosporium* on rubber-plants is mentioned on p. 195.

RUDBECKIA **Cucumber Mosaic** virus was recorded.

SAINTPAULIA **Crown Rot** (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.) was recorded on several cultivars in Sussex in 1966, and **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) was noted in Som in 1962. *Pseudomonas marginalis* (Brown) Stevens was isolated from blackened leaves on two Lea Valley nurseries in 1963.

SALVIA *Botrytis* caused losses in pricked-out plants. In Herts, Beds and Norfolk, a physiological condition appeared in frame-grown plants in 1963.

The upper leaves and growing points of cv. Blaze of Fire were distorted and of varying shades of yellow and pale green almost like sectoring. The seed supplier had seen the condition regularly in Blaze of Fire. These symptoms were associated with a check to growth particularly caused by cold or excess watering; and recovery, with more normal colouring, was apparent when the plants were put into a warm glasshouse.

SANSEVIERIA **Leaf Spot** (*Gibberella fujikuroi* (Saw.) Ito ap. Ito & Kimura) in the *Fusarium moniliforme* Sheldon stage was identified in Lindsey (Lincs) in 1967 and in Herts in 1968: these were considered to be new host records.

SAPONARIA **Leaf Spot** (*Alternaria dianthi* Stev. & Hall) affected seedlings in Essex in 1963. The previous record (Moore, *Br. Parasitic Fungi*, p. 53) was 10 years earlier.

SAXIFRAGE *Phytophthora* sp. was found in plants with **Root and Collar Rot** in Oxon in 1964, and **Rust** (*Puccinia pazschkei* Diet.) was noted in Norfolk in the same year (Brooks, *Jl R. hort. Soc.* 1966, **91**, p. 5).

SCABIOUS The rare **Leaf Spot** (*Ascochyta scabiosae* Rabenh.) (Plate XVI, 1) (see also p. 196) was identified in Kent in 1963. Also in 1963, J. H. Hawkins isolated *Verticillium dahliae* Kleb. in plants of cv. Clive Greaves with **Verticillium Wilt** in Beds. The plants, which were smaller than those unaffected, were yellowed, had dead outer leaves, and tended to wilt. Evidence pointed to propagating material as the source of infection. The following year the disease was again confirmed in Beds and also in I. of Ely. **Root Rot** has involved *Pythium* sp., *Phytophthora* sp. and *Rhizoctonia* sp. *Botrytis cinerea* Fr. was involved in distortion and rotting of flowers.

SCHIZANTHUS Both *Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. (see p. 196) and *P. cryptogea* Pethybr. & Laff., have been recorded on this host on the rare occasion: in 1969 both were isolated from mature plants with rotting crown roots in Yorks E.R. **Damping-off** (*Pythium* sp.) encountered in Middx in 1968 was new to England and Wales, while *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was associated with poor growth of potted plants in Brecon in 1967. Tomato **Spotted Wilt** and **Cucumber Mosaic** viruses were noted.

SCHIZOSTYLIS **Leaf Spot** (*Mycosphaerella macrospora* (Kleb.) Jørst.), reported earlier (see p. 196) from Devon, was diagnosed in Cornwall.

SEQUOIA The very common **Die-back** (*Botrytis cinerea* Fr.) was reported on nursery trees.

SHAMROCK **Rust** (*Uromyces trifolii* (DC.) Lév.) was slight in a small bed in Som in 1966.

SHRIMP PLANT **Leafy Gall** (*Corynebacterium fascians* (Tilford) Dowson) affected a few plants of *Beloperone guttata* and can be extensive and severe in this host.

SINNINGIA **A Leaf and Bud Rot** in Hants in 1965 was considered to be caused by *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. All 18,000 imported corms stored at 3-10°C were rotted and a species of *Pythium* resembling *P. echinulatum* Matthews was isolated. *Pythium debaryanum* Hesse had previously been found to be associated with a primarily non-parasitic corm rot (Moore and Tomlinson, *Pl. Path.* 1953, **2**, 71).

SKIMMIA **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was newly recorded on this host.

SNOWDROP A fungus believed to be *Ramularia vallisumbrosae* Cav. occurred on lesions on the leaf tips of shaded plants growing in heavy soil in Northants in 1967. This was thought to be a new host record.

SOLANUM CAPSICASTRUM **Foot Rot** (*Phytophthora nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh.) was noted.

SONERILA In the Lee Valley in 1966, the *Rhizoctonia* stage of *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was isolated from stunted plants of *Sonerila margaritacea* showing a marginal leaf scorch, dry brown lesions at soil level and brown roots.

SORBUS **Canker** (*Nectria galligena* Bres.) was found on shoots of rowan and other *Sorbus* spp. in the south-east in 1968. E. T. Roberts and A. G. Bailey found the disease on material from nurseries in Berks, Hants and Bucks and the disease was suspected on trees of *S. cashmiriana* in Surrey. Damage was sometimes considerable: rowans were severely girdled at the base, and pustules of the conidial stage, *Cylindrocarpon mali* (Allesch.) Wollenw., were found on the shoots. These appeared to be the first reports for this country of the disease on *Sorbus*. A species of *Cytospora* (see Peace, *Pathology of Trees and Shrubs*, pp. 531-2 for *Cytospora* spp. on *Sorbus*) affected a few trees of *S. majestica* on a nursery in Surrey. **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was found attacking white beam—apparently a new host record. Further *Sorbus* hosts of **Fireblight** (*Erwinia amylovora* (Burr.) Winslow *et al.*) have been reported (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

SPRUCE **Needle Blight** (*Lophodermium macrosporum* (Hartig) Rehm) caused defoliation of Norway spruce in Pemb, and **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was noted elsewhere. A species of *Phytophthora* was isolated from 6-in. tall plants of sitka spruce with **Root Rot** and browning of the needles in Surrey in 1968; a high proportion of the 13 acres was infected.

STACHYS The rarely reported **Powdery Mildew** (*Oidium* sp.) was seen in Lincs in 1962.

STATICE Damage to pricked-out seedlings on a Flints nursery in 1962 was attributed to *Alternaria alternata* (Fr.) Keissler.

STEPHANOTIS *Botrytis* sp. caused **Stem Rot** on a nursery in Yorks E.R.

STOCK **Downy Mildew** (*Peronospora parasitica* (Fr.) Fr.) was a common problem. **Canker** (*Leptosphaeria maculans* (Fr.) Ces. & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) was seen in a few crops, being severe and widespread in one. Occasionally noted were **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary), **Foot and Root Rot** (*Phytophthora cryptogea* Pethybr. & Laff.) and **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.).

STRANVAESIA **Fireblight** (*Erwinia amylovora* (Burrill) Winslow *et al.*) was again found on stranvaesias (Lelliott and Hayward, *Pl. Path.* 1965, **14**, 141-2).

STREPTOCARPUS **Foot Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was seen.

SUNFLOWER There was a report of **Sclerotinia Disease** (*Sclerotinia sclerotiorum* (Lib.) de Bary).

SWEET PEA **Downy Mildew** (*Peronospora viciae* (Berk.) Casp.) which has not been commonly reported on sweet peas in the past, was seen on several

nurseries near the coast in Cards and Merioneth in 1963 and 1964. '*Ascochyta*' diseases were of interest: some failures in Yorks and Lancs in 1964 were caused by *Mycosphaerella pinodes* (Berk. & Blox.) Vestergr., not previously noted on this host in this country; *Phoma medicaginis* Malbr. & Roum. var. *pinodella* (L. K. Jones) Boerema was an infrequent cause of **Foot Rot** while *Ascochyta pisi* Lib. was noted as causing **Leaf Spot** on two occasions. Another cause of foot rot was *Fusarium culmorum* (W. G. Smith) Sacc. In addition to the viruses mentioned on p. 198, which are frequent in sweet peas in this country, **Clover (White) Mosaic, Alfalfa Mosaic** and **Pea Leaf Roll** viruses have been isolated (Hull, *Pl. Path.* 1965, **14**, 150-3). The latter virus was reported in cvs. Astrid and Nancy in Sussex in 1966: symptoms were a rotting of the apex with leaf distortion and mottling.

SYCAMORE see Maple.

THUJA *Phoma thujana* Thüm (see Grove, *Br. Coelomycetes*, **1**, p. 79) was recorded in 1962 on two nurseries in Staffs and Herefs respectively. *Pestalotia funerea* Desm. was reported causing severe defoliation or **Die-back.**

TIBOUCHINA **Oedema** of the leaves of *T. semidecandra* was found in a glasshouse at the Royal Botanic Gardens, Kew in 1963 and 1965 and was thought to have been caused by environmental conditions (Reid, *Trans. Br. mycol. Soc.* 1969, **52**, 19-38).

TIGRIDIA Two aphid-borne viruses have been found in plants of *Tigridia pavonia* showing yellow striping (Brunt, *Rep, Glasshouse Crops Res. Inst. 1967*, 99).

TOBACCO The few reports of **Blue Mould** (*Peronospora tabacina* Adam.) in 1962 were referred to on p. 199. No other outbreaks of this disease have been encountered since. **Black Root Rot** (*Thielaviopsis basicola* (Berk. & Br.) Ferr.) caused stunting in an outdoor crop.

TORENIA **Collar Rot** (*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.) was noted.

TRADESCANTIA Extensive lesions were present on the leaves of plants being rooted in beds in the east Midlands in 1963. A similar leaf scorch together with loss of roots was considerable on a Lee Valley nursery in 1967. In both instances the *Rhizoctonia* stage of *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. was isolated, and on the Lee Valley nursery quintozene drench appeared to control it.

TRITONIA All plants in a 125 sq. ft area in Surrey in 1966 had **Dry Rot** (*Sclerotinia gladioli* Drayt.). Previously the fungus had only been noted on this host on imported corms (Moore, *Br. Parasitic Fungi*, p. 338).

TROLLIUS see Globe flower.

TULIP **Fire** (*Botrytis tulipae* Lind) continued as the most important disease, and **Shanking** (*Phytophthora cryptogea* Pethybr. & Laff. and *P. erythroseptica* Pethybr.) was often reported in forced tulips. **Grey Bulb Rot** (*Sclerotium tuliparum* Kleb.) and **Tobacco Necrosis** virus gave some trouble. **Fusarium Bulb Rot** (*Fusarium oxysporum* Fr. f. *tulipae* Apt) (see p. 200) was occasionally confirmed, mainly in imported bulbs but also in home-produced stocks in the east Midlands. In 1964. **Pythium Rot** (*Pythium* sp.) was reported to be common in imported stocks of Darwin hybrids, especially in cvs. Gudoshnik and Paris, in Norfolk. Root rot

associated with a species of *Pythium* was encountered in Kent, and *Armillaria mellea* (Fr.) Kummer was found to be affecting bulbs (Brooks, *Jl R. hort. Soc.* 1969, **94**, 4-10). *Papulaspora* sp. was associated with failure to root in cv. Golden Harvest in two stocks in the Eastern Region. **Cucumber Mosaic** virus was confirmed in a few crops in the east in 1967 and 1968; in one attack leaves and bulb scales were considerably necrosed. Symptoms similar to those referred to by K. M. Smith as caused by **'White Streak'** virus (*A Textbook of Plant Virus Diseases*, 2nd edn, p. 591) were seen on cv. William Copland in Cards in 1966, and pale-green leaf streaks and poor quality flowers were observed in a stock in Pemb in 1965. White streak virus is tentatively listed in C.M.I. *Phytopath. Paper*, No. 9 (p. 113) under tobacco rattle virus. Other viruses recorded were **Tobacco Rattle** and **Arabis Mosaic** (Brunt, *Rep. Glasshouse Crops Res. Inst. 1966*, 96). Symptoms of the abnormal shoot emergence in Copland cultivars (see p. 201) were again noted, in Rose Copland. The non-parasitic **Gummosis** which is seen occasionally on bulbs was widespread on English, and especially imported, bulbs of cv. Gudoshnik in the Eastern Region in 1964. **Papery Flowers** on some nurseries were attributed to overheating. **Chalking** (non-parasitic) was another occasional trouble.

VERBASCUM *Ramularia variabilis* Fuckel was identified on *Verbascum thapsiforme* in a garden in Hants (Deighton, *Trans. Br. mycol. Soc.* 1962, **45**, 474): it had apparently not been recorded before on verbascum in this country.

VERBENA **Damping-off** diseases were caused by *Pythium* sp. and *Corticium solani* (Prill. & Delacr.) Bourd. & Galz., neither mentioned previously on verbenas.

VERONICA Two, not uncommon, diseases, absent from reports for some time were **Leaf Spot** (*Septoria exotica* Speg.), in Herefs and the extreme south-west, and **Downy Mildew** (*Peronospora grisea* Unger) in Cornwall and, for the first time in the south-east, in Hants.

VIBURNUM *Cercospora tinea* Sacc. is sometimes seen on *Viburnum* spp. (Deighton, *Trans. Br. mycol. Soc.* 1966, **49**, 171; Brooks, *Jl R. hort. Soc.* 1966, **91**, 3-6). *Phytophthora*, *Pythium* and *Thielaviopsis* were all associated with a **Root Rot** complex in 2-year old plants and rooted cuttings in the Evesham Area; these fungi have not previously been noticed in this host. *Armillaria mellea* (Fr.) Kummer also caused root rot on occasions.

VIOLA Fungus diseases not encountered during 1957-61 but recorded in the later seven years on pansy were:- **Powdery Mildew** (*Oidium* sp.) which was severe in two crops in the eastern counties, **Downy Mildew** (*Peronospora violae* de Bary) on nurseries in Kent, **Rust** (*Puccinia violae* DC.) in Glam and in the south-east, and **Root Rot** caused variously by *Phytophthora cactorum* (Leb. & Cohn) Schroet., *P. nicotianae* B. de Haan var. *parasitica* (Dastur) Waterh. and *Pythium debaryanum* Hesse. *Phoma* sp. was again (see p. 203) involved, this time with *Fusarium* sp., in a severe root rot, under glass in Caerns. *Aphanomyces euteiches* Drechsl. has also been troublesome as a cause of root rot in recent years (Brooks, *Jl R. hort. Soc.* 1969, **94**, p. 5). **Leaf Spot and Crown Rot** (*Centrospora acerina* (Hartig) Newhall) had attacked plants in all boxes of pansies on a nursery in Sussex in November 1963. Although known abroad on this host, and

recorded in this country on various vegetables, the fungus had not previously been found on pansy here. The disease was extensive the following month on violet cv. Prince of Wales in Devon. Several other outbreaks on violets and pansies were recorded in later years. **Stem Rot** (*Botrytis cinerea* Fr.) was noted in violets. A bacterial **Leaf Spot** was seen on young plants of several dozen cultivars on a nursery in Bucks in 1967. The foci were small and scattered. A Group II *Pseudomonas* sp. of the *viridiflava* type and a Group IVb species were found. Symptoms of virus diseases, including **Cucumber Mosaic** virus, seem common in *Viola*.

WALLFLOWER **Canker** (*Leptosphaeria maculans* (Fr.) Ces & de Not. syn. *Plenodomus lingam* (Fr.) Höhn.) and **Root Rot** and related troubles caused by *Pythium* sp., were recorded.

WATER LILY **Leaf Spot** (*Ovularia nymphaearum* Allesch.) was seen on several species in a tank in Surrey in 1963.

WHITE BEAM see *Sorbus*.

WILLOW **Scab** (*Venturia chlorospora* (Ces.) Karst.) and **Anthracnose** (*Marssonina salicicola* (Bres.) Magn.) are common troubles, the latter sometimes making trees unsaleable. **Branch Canker** (*Discella carbonacea* (Fr.) Berk. & Br.) was reported from Norfolk, Essex and Som. In one instance it accompanied *Phoma* sp. and in another *Pseudomonas syringae* van Hall. Black canker on main stems and branches of many trees of *Salix vittelina pendula* in Surrey in 1968 were associated with *Fusarium* sp.: branches were dying but the roots were healthy. *Cytospora* sp. was thought to be involved in another attack of a black canker affecting *S. babylonica* in Caerns: *C. chrysosperma* Fr. is common on willows but there is doubt about its pathogenic status (Moore, *Br. Parasitic Fungi*, pp. 125-6; Peace, *Pathology of Trees and Shrubs*, p. 461). **Sooty Mould** (*Cladosporium* sp.) had affected trees examined in mid-Wales.

WISTARIA **Leaf Spot** (*Septoria wistariae* Brun.) was noted in Hants.

YEW **Armillaria Root Rot** (*Armillaria mellea* (Fr.) Kummer) was met with on occasions.

YUCCA Reported as a new host in this country for the **Root Rot** fungus *Armillaria mellea* (Fr.) Kummer.

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